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VOLUME 14 MAY, 1940 NUMBER 3

MOLLUSKS OF THE CHICKASAWHAY MARL

WENDELL C. MANSFIELD

ABSTRACT—The mollusks of the lower, typical part of the Chickasawhay marl of Mississippi and Alabama indicate that the formation is contemporaneous with the upper Oligocene Flint River formation of Georgia and Suwannee limestone of Florida. The upper beds contain a smaller fauna that appears to be contemporaneous with that of the lower Miocene Tampa limestone of Florida.

PREFATORY NOTE

WHEN Wendell Clay Mansfield died suddenly on July 24, 1939, he left behind him in collections and manuscript papers the results of some 18 months of work in the field and in the laboratory on the mollusks of the Chickasawhay marl of eastern Mississippi and western Alabama. His stratigraphic notes were not organized, but his faunal determinations and descriptions were nearly completed. These have been assembled and revised by Julia Gardner, his colleague in the Geological Survey. K. E. Lohman, in charge of the Photomicrographic Laboratory, and N. W. Shupe, photographer, coöperated in the completion of the illustrations.

Doctor Mansfield's training for the study of the Chickasawhay was exceptional, for he was familar with the mollusks of the upper Oligocene Flint River formation of Georgia and had reported on the synchronous Suwannee fauna of Florida and those of the succeeding Miocene Tampa limestone. His final work on the Chickasawhay faunas is herewith presented.

The name Chickasawhay, taken from a river in southeastern Mississippi, was used in the guidebook of the eleventh annual field trip of the Shreveport Geological Society (Blanpied et al., 1934) to designate certain marine deposits in Wayne County, Mississippi, and partly equivalent beds in Alabama that had previously been included in the Oligocene Byram marl (Cooke, 1926). The authors of the guidebook divided the Chickasawhay into two members, an upper and a lower, about whose ages they expressed a diversity of opinion, some holding that both members are Miocene, representing a marine facies of the Catahoula sandstone, and others that the lower member is Oligocene. Cooke (1935) rejected the reference to the Catahoula but adopted the unit as a marl member of the Byram marl above the Bucatunna clay member. He regarded the Chickasawhay marl member of the Byram as probably equivalent in age to the newly named Flint River formation of Georgia, basing his correlation on preliminary studies of fossils from the lower member. Later, under the name Chickasawhay marl, he treated it as an independent Oligocene formation contemporaneous with the Flint River formation and the Suwannee limestone of Florida (Cooke, 1939).

The great majority of the species described herein occur in the lower member, which should be considered the typical part of the formation. The most significant species from these beds are named in the accompanying list, prepared by Miss Gardner, which indicates very close relationship to

the Suwannee limestone and the Flint River formation, and more distant affinities with the somewhat older Byram marl. This confirms Cooke's (1935, 1939) correlation.

Ten species occur in somewhat younger beds, which are referred by Mansfield to the upper part of the Chickasawhay marl (upper Chickasawhay member of Blanpied

SOME SPECIES IN THE LOWER, TYPICAL PART OF THE CHICKASAWHAY MARL

Species of possible stratigraphic significance	Byram marl	Flint River formation	Suwannee limestone	Tampa limestone	Related forms from other formations
Glycymeris cf. *G. suwanneensis* Mansfield.	—	—	cf	—	*Glycymeris suwanneensis* Mansfield
Anadara mummi Mansfield.....	cf	—	x	—	*Anadara lesueuri* (Dall)
Anadara macneili Mansfield.....	—	—	x	—	
Brachidontes mississippiensis (Conrad)...	x	—	—	—	
Arcoperna inflata Dall?.....	—	?	—	—	
Pteria cf. *P. argentea* Conrad.....	cf	—	—	—	*Pteria argentea* Conrad
Chlamys howei Mansfield, n. sp.....	—	—	cf	—	*Chlamys* aff. *C. vaun wythei* Hertlein
Chlamys mcguirti Mansfield, n. sp.....	—	cf	—	—	"*Pecten suwanneënsis*" Dall (in part)
Chlamys chickaria Mansfield, n. sp.....	—	—	?	—	
Chlamys aff. *C. duplex* (Cooke).....	—	—	—	—	*Chlamys duplex* (Cooke) described from Anguilla
Ostrea vicksburgensis Conrad.....	x	x	x	—	
Crassatellites paramesus Dall.....	—	x	—	—	
"*Venericardia*" *waynensis* Mansfield, n. sp.	—	cf	cf	—	"*Venericardia*" *serricosta brooksvillensis* Mansfield
Miltha cf. *M. chipolana* Dall.....	—	—	?	—	
Miltha cf. *M. hillsboroensis* (Heilprin)....	—	?	?	—	*Miltha hillsboroensis* (Heilprin)
Miltha? hernandoensis Mansfield.....	—	—	?	—	
Divaricella sp.....	—	—	?	—	
Trigoniocardia cf. *T. gadsdenense* Mansfield.....	—	—	?	—	
Nemocardium diversum waynense Mansfield, n. subsp.....	cf	—	—	—	*Nemocardium diversum* Conrad
Macrocallista cf. *M. sobrina* (Conrad)....	cf	—	—	—	*Macrocallista sobrina* (Conrad)
Chione bainbridgensis Dall.....	—	x	x	—	
Chione catunna Mansfield, n. sp.....	—	—	—	cf	*Chione* (*Chamalea*) *rhodia* Dall
Corbula laqueata Casey?.....	?	—	—	—	
Corbula taylorensis Mansfield, n. sp.....	cf	—	—	—	*Corbula engonata* Conrad
Panope taylorensis Mansfield, n. sp.....	—	—	?	—	
Kuphus incrassatus Gabb.....	—	—	x	—	
Terebra waynesboroensis Mansfield, n. sp..	cf	—	—	—	*Terebra tantula* Conrad
Conus aff. *C. imitator* Brown and Pilsbry..	—	—	x	—	
Pleurofusia cf. *P. vicksburgensis* Casey...	cf	—	—	—	*Pleurofusia vicksburgensis* Casey
Fusiturricula cf. *F. servata* (Conrad).....	cf	—	—	—	*Fusiturricula servata* (Conrad)
Tropisurcula cf. *T. caseyi* (Aldrich).....	cf	—	—	—	*Tropisurcula caseyi* (Aldrich)
Syntomodrillia? cf. *S.? tantula* (Conrad)..	cf	—	—	—	*Syntomodrillia? tantula* (Conrad)
Scobinella taylorensis Mansfield, n. sp....	cf	—	—	—	*Scobinella caelata* Conrad
Olivella cf. *O. affluens* Casey.....	cf	—	—	—	*Olivella affluens* Casey
Lyria cf. *L. mississippiensis* (Conrad)...	—	—	x	—	
Tritiaria cf. *T. vicksburgensis* Aldrich....	cf	—	—	—	*Tritiaria vicksburgensis* (Aldrich)
Metula taylorensis Mansfield, n. sp.....	cf	—	—	—	*Metula fragilis* Casey
Rapana cf. *R. vaughani* Mansfield.....	—	—	—	cf	*Rapana vaughani* Mansfield
Scalina cf. *S. trigintanaria* Conrad.....	cf	—	—	—	*Scalina trigintanaria* Conrad
Cassis flintensis Mansfield, n. sp.....	—	x	x	—	
Sconsia cf. *S. lintea* (Conrad).....	cf	—	—	—	*Sconsia lintea* (Conrad)
Ficus mississippiensis Conrad?.....	?	—	x	—	
Turritella cf. *T. gatunensis* Conrad.....	—	—	x	—	
Turritella monroensis Mansfield, n. sp....	—	cf	—	—	*Turritella halensis* Dall
Turritella aff. *T. bowenae* Mansfield.....	—	—	cf	—	*Turritella bowenae* Mansfield
Pachycrommium sp.....	—	?	?	—	
Sinum cf. *S. mississippiense* (Conrad)...	cf	—	x	—	*Sinum mississippiense* (Conrad)

et al., 1934). These species show close relationship to and some identities with species in the Miocene Tampa limestone of Florida, and perhaps the beds containing them should be referred to that formation rather than to the Chickasawhay. These species are: *Barbatia* cf. *B. marylandica* Conrad, *Mytilus* (*Mytiloconcha*) sp., *Atrina* aff. *A. argentea* Conrad, *Ostrea blanpiedi* Howe (1937), *Anodontia* sp., *Cardium* cf. *C.* (*Cerastoderma*) *phlyctaena* Dall, *Cancellaria* (*Trigonostoma*) sp., *Fasciolaria* cf. *F. petrosa* Dall, *Petaloconchus varians* d'Orbigny, and *Ampullina* (*Ampullinopsis*) *amphora* Heilprin.

The collections on thich this study is based are in the U.S.National Museum.

—*C. Wythe Cooke*

SYSTEMATIC DESCRIPTIONS

Genus NUCULANA Link

NUCULANA WAYNENSIS Mansfield, n. sp.

Plate 25, figure 25

Shell rather small, thin, full, inequilateral. Anterior margin well-rounded. Posterior extremity narrowed, truncate. Base broadly arcuate. Beak low, obtuse, devoid of sculpture. Lunule linear; escutcheon linear-lanceolate, defined by the obscure angulation of the shell and the strong concentric lamination. Sculpture feeble, restricted to a concentric striation, most distinct and most crowded on the medial portion of the disk and toward the ventral margin, faint toward the anterior dorsal margin, and obsolete on the rostrum. Ligament pit minute, subumbonal, wider than high. Teeth strong, taxodont, elevated medially, about 22 in the anterior series, about 18 in the posterior series.

Holotype (U. S. Nat. Mus. 498508, a left valve) measures: Width, 11.2 mm; height, 5.4 mm; diameter of single valve, 2.2 mm.

Occurrence.—Lower part of Chickasawhay marl at station 14204, Taylor Mill Creek, blue marl bed just east of bridge on Highway 45, 1½ miles north of Waynesboro, Wayne County, Miss.

The species most closely resembling *Nuculana waynensis* Mansfield is an undescribed form from the Byram marl at Vicksburg, Miss. The Chickasawhay species, however, is larger than the Vicksburg form, more produced, and more constricted posteriorly.

Nuculana waynensis is known only from the holotype and a broken topotype.

Subgenus SACCELLA Woodring

NUCULANA (SACCELLA?) TAYLORENSIS Mansfield, n. sp.

Plate 25, figures 24, 26

Shell rather small, moderately thin and full, equivalve, inequilateral. Anterior margin rounded; posterior margin narrow and subtruncate; base broadly arcuate. Beaks low, obtuse, very feebly sculptured. Lunule feebly indicated. Escutcheon sunken, linear-lanceolate, defined by a low ridge and laminated by the strong growth sculpture. Surface sculptured with closely spaced, flat-lying concentric lamellae, most distinct on the medial part of the disk and crowded toward the ventral margin, obsolete near the anterior dorsal margin and on the rostrum and in the depression immediately in front of it. Ligament pit minute, wider than high. Teeth taxodont, small, crowded, about 20 in the anterior series and 18 in the posterior.

Holotype (U. S. Nat. Mus. 498509, a left valve) measures: Height, 5.0 mm; width, 9.5 mm; diameter of a single valve, 2.4 mm. Both holotype and paratype, a broken right valve U. S. Nat. Mus. 498510, are from station 14204, Taylor Mill Creek, blue marl bed just east of bridge on Highway 45, 1½ miles north of Waynesboro, Wayne County, Miss.

Nuculana taylorensis is a shorter, less slender shell than *N. waynensis* described from the same locality. Small specimens from station 14368, Jay Branch above the road from Perdue Hill to Mount Pleasant Landing, Monroe County, Ala., are similar in sculpture to those from Taylor Mill Creek but are relatively shorter and higher. The anterior depression is wanting in *N. taylorensis*, but in the other characters it agrees very well with the widely distributed *Saccella*.

Occurrence.—Lower part of the Chickasawhay marl. ALABAMA: Station 10334?, one-fourth mile northeast of Perdue Hill, Monroe County, Ala. (incomplete external mold). MISSISSIPPI: Station 14204, Taylor Mill Creek, blue marl bed just east of bridge

on Highway 45, 1½ miles north of Waynesboro; station 14345?, sec. 34, T. 9 N., R. 7 W., Sandy Creek (a single incomplete valve); station 14349, glauconitic bed near base of Chickasawhay River section, one-fourth mile downstream from highway bridge, 2½ miles west of Waynesboro, Wayne County (molds only).

Genus GLYCYMERIS Da Costa
GLYCYMERIS sp. cf. G. SUWANNEENSIS Mansfield
Plate 25, figure 4

Specimens of *Glycymeris* displaying the general form and finely cancellate sculpgeneral form and finely cancellate sculpture of *G. suwanneensis* Mansfield, 1937, are recorded in molds and in the original shell at a few localities in the lower part of the Chickasawhay marl. The beaks seem a little more full at the extreme tips in the forms from Alabama, but the relationship to the species from the upper Oligocene of Florida is certainly close. The Flint River specimens referred by Dall, 1916, to *Glycymeris mississippiensis* are triple the size of Conrad's type and close to *G. suwanneensis*. In Conrad's brief description he includes as one of the characteristics "series of teeth uninterrupted." This, together with the small size, about 10 mm, according to the figure, indicates a young shell, but no adult topotypic material certainly referable to *mississippiensis* has been observed in the collections of the U. S. National Museum. Apparently there was, in the upper Oligocene of the Gulf province, a widespread group characterized by a subcircular outline; a shell broadly inflated and full even to the tips of the beaks, closely but somewhat obscurely threaded radially, and closely lirate concentrically, the minute interspaces giving a somewhat punctate aspect to the surface. The distal teeth are coarse and oblique, the subumbonal dentition finer and vertical. The line is, perhaps, continued in *Glycymeris americana* Defrance of the later Tertiary and Recent faunas of the East Coast and West Indian faunas.

Figured specimens (U. S. Nat. Mus. 498511) measures: Height, 25.5 mm; width, 27.0 mm; convexity of single valve, 8 mm.

From station 14205, in soft marl under limestone ledge in gully about one-fourth mile north of Perdue Hill, Monroe County, Ala. A closely related if not identical species is recorded in the Mint Spring marl member of Marianna limestone at station 14203 on Horton's Mill Creek and at station 6647*a*, 1⅓ miles southwest of Boyce, Wayne County, Miss.

Occurrence.—Lower part of Chickasawhay marl. ALABAMA: Station 14205, one-fourth mile north of Perdue Hill, Monroe County; station 14323?, highest fossiliferous bed in ravine 200 yards south-southwest of Jones' old plantation house, about 1 mile northwest of Glendon Station (internal mold); station 7166?, east side of Tombigbee River, just south of Payne's Hammock, Clarke County (internal mold). MISSISSIPPI: Station 14283?, "Chione limestone" at top of hill on old road leading down to Lime stone Creek, 3 miles north of Waynesboro, (external mold). A few other internal molds from the lower Chickasawhay of western Alabama and eastern Mississippi may be conspecific with the Perdue Hill specimens.

GLYCYMERIS sp.
Plate 25, figure 36; plate 26, figure 13

Specimens of a small *Glycymeris* preserved as incomplete external molds are characterized by the breaking down of the primary ribbing on the ventral part of the shell. *Glycymeris arctata* (Conrad) ,1848, from the Red Bluff clay, and *G. cookei* Dall, 1916, from the Flint River formation, show a somewhat similar sculpture, but *G. arctata* runs larger and is less inflated. In *G. cookei* the anterior dorsal margin seems less produced than in this species. In all three of the forms the concentric growth laminae are unusually regular and prominent.

The height of the mold (U.S.N.M. 498512) is 13 mm. The locality is station 10334, the lower part of the Chickasawhay marl, one-fourth mile northeast of Perdue Hill, Monroe County, Ala.

Similar molds are found at station 2398 and at 14205*a*, which are probably identical with station 10334. A somewhat more inflated form (pl. 25, fig. 36) occurs in the lower Chickasawhay at station 6753, on the east side of Conecuh River at Old Weaver Chute, 2 or 3 miles below McGowans bridge, Escambia County, Ala. The difference may, however, be individual.

External molds indicating a shell even more closely resembling *Glycymeris arctata* is fairly common in the Chickasawhay at station 7211, on the east bank of Murder Creek, about 3 miles north of Castleberry, Conecuh County, Ala. *Glycymeris canalis* Brown and Pilsbry from the Gatun formation of the Canal Zone may be a later representative of the group. The fragment of an external mold from station 14287, on Patton Creek, 1½ miles east of Waynesboro, Wayne County, Miss., recalls *G. cookei* in sculpture and in outline, though it seems relatively broader and more symmetrical than the Flint River species.

Genus BARBATIA Gray

BARBATIA sp. cf. B. MARYLANDICA Conrad

Plate 25, figure 5

Incomplete external molds from the upper part of the Chickasawhay marl should probably be referred to the group of *Barbatia marylandica* Conrad. The form is rather common at a single locality, station 14287, the waterfall on Patton Creek, a quarter of a mile above Highway 45, 1½ miles east of Waynesboro, Wayne County, Miss. More than a single unit has probably been included under *marylandica*, for the Tampa species does not seem identical with the Maryland individuals. Certainly the constriction of the anterior portion of the shell is much more marked in the Calvert type than it is in the Tampa forms. The molds of *Barbatia* sp. cf. *B. marylandica* are more evenly rounded anteriorly than in the Vicksburg species, *Barbatia mississippiensis* Conrad, and the radial sculpture is more regular.

Barbatia marylandica, s. l., has been recorded in the lower and middle Miocene from New Jersey to Florida, and a few molds from the upper Oligocene (Suwannee) limestone of Florida have been questionably referred to it.

The figured specimen is the mold of an incomplete left valve (U. S. Nat. Mus. 498513), from the upper Chickasawhay at station 14287.

BARBATIA sp. cf. B. CUCULLOIDES Conrad

Plate 25, figure 3

Molds from the lower part of the Chickasawhay marl at station 10334, a quarter of a mile northeast of Perdue Hill, Monroe County, Ala., have preserved no characters by which they may be separated from *Barbatia cuculloides* (Conrad) from the upper Eocene and Oligocene of the eastern, middle, and western Gulf province. The material is fragmentary, but it retains the characteristic ribbing pattern on the medial and posterior parts of the shell; the strong radial outlining the posterior keel; in front of the keel, a few strong but irregular radials, and behind it, a convex, cuneate area extending from the umbones to the outer margin and sculptured with incrementals and finer and more or less obsolete radials.

The species is represented at the single locality and is too imperfectly preserved to be specifically determinable.

The figured right valve from station 10334 is U. S. Nat. Mus. 498514.

Subgenus ACAR Gray

BARBATIA (ACAR) sp. cf. B. (ACAR) DOMINGENSIS (Lamarck)

Plate 25, figure 11

External molds displaying the characteristic form and sculpture of the *Barbatia domingensis* group were recovered from the lower part of the Chickasawhay marl at station 7166, on the east bank of the Tombigbee River, just south of Payne's Hammock, Clarke County, Ala. The characters of the hinge and ligament areas are not known. The type of *B. domingensis* (Lamarck) is a Recent shell, but conspecific or closely related forms are recorded in the Gulf and mid-American provinces throughout the Tertiary, particularly since the opening of the Miocene. The group has a meagre representation in the Eocene of Mississippi and the Western Gulf, and this is one of the few lower Chickasawhay occurrences recorded in the Oligocene faunas.

The figured specimen is a right valve, U. S. Nat. Mus. 498515.

Genus ANADARA Gray

ANADARA MUMMI Mansfield

Plate 25, figures 6, 8;
plate 26, figures 12, 14

Anadara mummi MANSFIELD, *1938*, Washington Acad. Sci., Jour., vol. 28, no. 3, p. 104, fig. 14.

The holotype of *Anadara [mummi* (U.S.

N.M. 497651) measures about 20 mm in height and in width and about 9 mm in the convexity of the single valve. It is from the Suwannee limestone at station 12723, the upper bed on the H. L. Parrish farm, 3½ miles southeast of Wausau, Washington County, Fla. The figured specimens are right and left valves (U.S.N.M. 498677) from station 14204.

Anadara mummi differs from the closely related *A. lesueuri* (Dall) from the Byram marl, in the more quadrate outline and the more closely spaced ribs, especially those of the right valve. The shell in *A. mummi* is heavier and shorter than that of the coexistent *A. macneili* and is more truncate posteriorly. The ribs are medially sulcate away from the umbones as they are in *A. macneili*, but there is no tendency toward the development of a secondary groove on either side of the primary sulcation. In *A. macneili* the adult ribs break down toward the ventral margin into pairs of double ribs, but in *A. mummi* there is only the single division of the primary ribs. However, in poorly preserved and not fully adult specimens, the separation of *A. mummi* and *A. macneili* is difficult or impossible.

Occurrence.—Lower part of Chickasawhay marl. Station 13239, NW ¼ sec. 17, T. 8 N., R. 5 W., Bucatunna Creek; station 14282, blocks of "*Chione* limestone" along side road of Limestone Creek, 3 miles north of Waynesboro; station 14204, lower bed of blue marl, just east of highway bridge on Highway 45, 1½ miles north of Waynesboro; station 14349, bed no. 4, greensand bed of Chickasawhay River section, 2½ miles west of Waynesboro, Wayne County, Miss.

ANADARA MACNEILI Mansfield
Plate 25, figures 1, 2

Anadara macneili MANSFIELD, *1938*, Washington Acad. Sci., Jour., vol. 28, no. 3, p. 103, figs. 12, 17, 18.

The radial ribs on this species are rather strongly beaded. They begin to divide at about the convexity of the valve into two proximate ribs, the median groove deepening and widening ventrally. A further division takes place near the ventral margin so that on either side of the strong medial sulcation there is a secondary groove, and the original rib is divided into two more or less clearly defined pairs of radials.

The holotype is a left valve (U.S.N.M. 497648) measuring about 25 mm in length and 20 mm in width. It was collected from the Suwannee limestone, stations 10461 and 12723, at the A. L. Parrish farm, 3½ miles southeast of Wausau, Washington County, Fla. The specimens figured in the present report are left valves (U.S.N.M. 498673 and 498674) from the lower Chickasawhay at station 14205, the gully about a quarter of a mile north of Perdue Hill, Monroe County, Ala.

Occurrence.—Lower part of Chickasawhay marl. ALABAMA: Stations 6758 and 14292, the south bank of Yellow River at Watson [Watkins] and Henderson wagon bridge, 4 miles north of the Florida line, Covington County; stations 6753 and 14293, the fossiliferous bed at Weaver's Chute on the east side of the Conecuh River, 2 or 3 miles below McGowan's bridge, Escambia County; station 14205, soft marl in gully about a quarter of a mile north of Perdue Hill; station 14205*a*, limestone overlying soft marl in gully about one-fourth mile north of Perdue Hill; station 10334, one-fourth mile northeast of Perdue Hill, Monroe County; station 14323, highest fossiliferous bed in ravine 200 yards south-southwest of Jones' old plantation house, about 1 mile northwest of Glendon Station; station 7166, east bank of Tombigbee River, just south of Payne's Hammock, Clarke County; stations 13381, 14291, about 1.3 miles north of Millry, Washington County. MISSISSIPPI: Station 13396, hillside above mouth of Limestone Creek, near middle of sec. 25, T. 9 N., R. 7 W.; station 14519, old road on east side of new road, south of Limestone Creek, about half a mile up the hill; station 14281, "*Chione* limestone," Taylor Mill Creek, 1½ miles north of Waynesboro, Wayne County.

Genus BRACHIDONTES Swainson
BRACHIDONTES MISSISSIPPIENSIS (Conrad)
Plate 25, figure 40

Modiola mississippiensis CONRAD, *1847*, Acad. Nat. Sci. Philadelphia, Proc., vol. 3, p. 295.

Modiola mississippiensis CONRAD, *1848*, Acad. Nat. Sci. Philadelphia, Jour., 2d ser., vol. 1, p. 126, pl. 12, fig. 19.

Modiolus (*Brachydontes*) *mississippiensis* Conrad. DALL, *1898*, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 796.

The rostral fold is acute near the umbones but broadens and flattens toward the ventral margin. The rostral area and that behind it are covered with a close, flat, radial lineation. In front of the rostral area, the radial sculpture abruptly ceases, and only the incremental sculpture remains. On the short, narrow anterior lobe in front of the beaks, a few short radial lirae are developed. They are strongest toward the front and evanesce away from the lateral margin. The holotype is from the Byram marl at Vicksburg, Miss.

The species exhibits the characteristic sculpture of *Musculus*, but it far exceeds the dimensions of that small form.

The specimens from the lower part of the Chickasawhay marl of southern and western Alabama and eastern Mississippi cannot be separated from the topotypes. The figure illustrates a mold of the exterior of a left valve (U.S.N.M. 498534), about 28 mm in its greatest dimension, from the lower Chickasawhay at station 6758, on the south bank of the Yellow River, 4 miles north of the Florida line in Covington County, Ala.

Occurrence.—Lower part of the Chickasawhay marl. ALABAMA: Stations 6758 and 14292, site of Watson and Henderson bridge, on the south bank of the Yellow River about 4 miles north of the Florida line, Covington County; station 7166, east bank of the Tombigbee River, just south of Payne's Hammock, Clarke County. MISSISSIPPI: Station 14204, lower bed of blue marl east of bridge on Highway 45, 1½ miles north of Waynesboro; station 13241, Rocky Creek, sec. 18, T. 8 N., R. 5 W., Wayne County.

Genus ARCOPERNA Conrad
ARCOPERNA INFLATA Dall

Arcoperna inflata DALL, *1916*, U. S. Nat. Mus., Proc., vol. 51, p. 494, pl. 85, fig. 1.

Shell small, thin, inequilateral, the umbones nearly terminal, prosocoelous, small; the anterior dorsal slope abruptly descending, the posterior nearly at a right angle to it, slightly convexly arcuate; both ends bluntly rounded, base almost straight; hinge edentulous, much as in *Musculus;* inner margins of the valve apparently smooth, interior disk concealed by matrix; the external sculpture of almost microscopic radial striae over the whole surface, and concentric emphatic resting stages irregularly disposed on the lower part of the disk, to the number of two or three. Height, 12; length, 18.5; diameter (double), 9 mm.

Locality.—At station 7096, at Red Bluff, Flint River, on the west bank, 7 miles above Bainbridge, Decatur County, Georgia; Vaughan, Cooke, and Mansfield, 1914. U. S. Nat. Mus. Cat. No. 166714.

This shell seems to find a place halfway between *Crenella* and *Botula*. The type is *A. filosa* Conrad, from the Vicksburgian, from which the present shell differs by its much less prominent umbones and dorsally less and ventrally more arcuate profile. DALL, 1916.

The horizon is the Flint River formation.

Arcoperna inflata Dall is probably represented by external molds from two localities in the lower Chickasawhay, the one, station 6753, Weaver Chute on the east side of the Conecuh River, 2 or 3 miles below McGowan's Bridge, Escambia County, Ala.; the other, station 13396, the hillside above the mouth of Limestone Creek, near the middle of sec. 25, T. 9 N., R. 7 W., Wayne County, Mississippi. The outlines are too incomplete to form sufficient basis for determination, but the diagnostic sculpture is retained and offers strong evidence of the identity of the Alabama and Mississippi forms with that from Georgia. The radial sculpture of *inflata* is exceedingly fine and crowded with an occasional conspicuously heavy resting stage; that of the genotype from Vicksburg is almost equally fine, but it is interrupted by the overriding incrementals. The radial sculpture on the Alabama and Mississippi molds is identical with that from the Flint River formation of Georgia.

Genus MYTILUS Linnaeus
Subgenus MYTILOCONCHA Conrad
MYTILUS (MYTILOCONCHA) sp.

Warped internal molds occur in considerable abundance in the upper part of the Chickasawhay marl at station 14289, near the top of the Chickasawhay River section, one-fourth mile downstream from the bridge on the Waynesboro-Laurel highway, 2½ miles west of Waynesboro. The matrix is a gray clay impregnated with angular grains of clear quartz. The molds indicate a rather slender, arcuate species about 60 mm in length and 25 mm in width, similar in a general way to *Mytilus* (*Mytiloconcha*) *incurvus* Conrad, 1839, described from Calvert County, Md., and occurring both in the Calvert and in the Choptank. The upper Chickasawhay species is smaller, however, than the Chesapeake form and more slender. It

is much smaller also than a species from the Hawthorn formation in Wakulla County, Fla., which is similar to if not identical with the Maryland form. The characters retained by the Mississippi species are not sufficient to permit a specific identification.

Genus PTERIA Scopoli
PTERIA sp. cf. P. ARGENTEA Conrad
Plate 25, figure 7

A somewhat crushed and damaged specimen of *Pteria* from the Chickasawhay marl of Perdue Hill, Monroe County, Ala., has preserved no characters by which it can be certainly separated from *Pteria argentea* Conrad, 1848, described from Vicksburg, Miss. It is possible that the form from Perdue Hill is not so much produced posteriorly and is less oblique than the Vicksburg form, but more probably, though the original shell is retained, the margins are broken so that the outline assumes a more quadrate aspect than that of the perfect shell. The dorsal parts, the beak, and the auricles are similar in the Perdue Hill and Vicksburg examples.

The figured right valve (U.S.N.M. 498516), is a little more than 25 mm in width along the dorsal margin. The locality from which it comes is station 14205, the soft marl under the ledge in the gully about one-fourth mile north of Perdue Hill, Monroe County, Ala. Molds of an apparently identical species occur in the lower Chickasawhay above; at station 10334, one-fourth mile northeast of Perdue Hill, and at station 13396, the hillside above the mouth of Limestone Creek, near the middle of sec. 25, T. 9 N., R. 7 W., Wayne County, Miss.

Genus ATRINA Gray
ATRINA sp. aff. A. ARGENTEA Conrad

Indeterminate molds, not necessarily conspecific, from two localities establish the presence of the genus *Atrina* in the Chickasawhay marl in western Alabama and eastern Mississippi. In shell structure, outline, and in the faint traces of ornamentation, the forms recall *Atrina argentea* Conrad, 1848, described from Vicksburg, Miss. Fragmentary internal molds and molds of the exterior were collected at station 7165, bed no. 5 in the bluff section east of the Jackson-Rockville road, 200 yards north of Salt Creek, NW ¼ sec. 34, T. 6 N., R. 2 E., 4½ miles south of Jackson, Clarke County, Ala. A few fragments of shell still cling to an internal mold from the upper part of the Chickasawhay marl from station 14287, the waterfall on Patton Creek, one-fourth mile above Highway 45, 1½ miles east of Waynesboro, Wayne County, Miss.

Genus CHLAMYS "Bolten" Roeding
Subgenus PLAGIOCTENIUM Dall
CHLAMYS (PLAGIOCTENIUM) HOWEI
Mansfield, n. sp.
Plate 26, figures 1, 3, 4

Shell small for the group, thin, fragile; the outline between the submargins an arc of not far from 240°; left valve flattened in the umbonal area, very feebly inflated medially; right valve feebly inflated, both in the umbonal and the medial areas. Prodissoconch retained on many individuals, a minute porcellaneous cuneate shell, smooth except for feeble concentric wrinkles, the beak acute and interrupting the dorsal margin. Primary costals originating at the outer margin of the prodissoconch, not increasing by intercalation; 17 or 18 in number, usually 18, low, rounded, as wide or slightly wider than the intercostals; nonlirate or with feeble, fortuitous threading. Concentric imbrications thin, sharp, very regular, overriding the radials, and looped backward slightly toward the umbones as they cross the costals, and forward toward the ventral margins at the intercostals. Submargins low, smooth, angular. Auricles rather wide, moderately high; nonlirate except for 1 to 3 fortuitous threads on occasional specimens. Byssal notch shallow; ctenolium absent. Cardinal margins turned inward and a little downward, bevelled, the inner edge acute. Cardinal crura in right valve more strongly developed than those in the left, rudely parallel to the dorsal margin. Ligament pit small, deltoid. Single muscle impression obscure, circular, included for the most part within the upper posterior quadrant. Inner margins crenate in harmony with the primary ribbing,

Holotype (U. S. Nat. Mus. 498517, a left valve) measures: Height, 49.0 mm; width, 50.0 mm; convexity, 5.0 mm. Paratype, (U. S. Nat. Mus. 498518, a right valve) measures: Height, 36.4 mm; width, 39.0

mm; convexity, 6.6 mm. Figured specimen (U. S. Nat. Mus. 498519, a right valve) measures: Height, 45.0 mm; width, 47.0 mm; convexity, 9.0 mm. Holotype and paratype from station 14204, lowest bed at bridge over Taylor Mill Creek, on Highway 45, 1½ miles north of Waynesboro, Wayne County, Miss. Figured specimen from station 14286, east of prisoners' house at State Quarry, 3 miles north-northwest of Waynesboro, Wayne County, Miss.

Chlamys howei may be known by its compressed, subcircular outline and rather low, smooth ribs overridden by the unusually even, concentric imbrications. The species varies somewhat in the degree of inflation, but the widest range of variation is in the form of the ribs and the occasional development of an obscure secondary liration on the primary costals. Commonly there is a single low thread cresting the rib and giving it an obscurely V-shaped outline, and occasionally near the ventral margin a secondary is developed on either side of the medial threading, thus squaring the costal. This is particularly noticeable in those specimens in which the intercostals are unusually flat and the angle of intersection with the costals acute. Such variants occur in the same lump with typical *C. howei* and are not considered to be of taxonomic significance.

Chlamys howei is probably related closely to a specimen from the Suwannee limestone of Florida figured by Mansfield, 1937, under the name of *Chlamys* (*Aequipecten*) sp. aff. *C. vaun wythei* Hertlein, a replacement name for *Pecten vaughani flabellum* Cooke, 1919, from the Miocene of Santa Cruz and Santiago, Cuba. The Cuban shell is smaller than either of the Oligocene forms, the auricles distinct, the dorsal margins more produced and the arc included between their extremities not more than 180°. In the Suwannee species the costals are fewer and more prominent than those of *C. howei*. A form even more closely related to *Chlamys howei* may be represented in the Flint River formation in Decatur County, Ga., though the specimen in question is incomplete, and the relationship cannot be determined with assurance. The two species are similar in general aspect, but the costals of the Georgia form are more numerous by two or three. *Pecten* (*Aequipecten*) *effosus* Brown and Pilsbry, 1911, from the Gatun formation of the Canal Zone is similar in outline but differs in the somewhat more elevated and angular costals and the lirate auricles.

The species has not been recorded in western Mississippi. It is named in honor of Dr. Henry V. Howe, the head of the Department of Geology at Louisiana State University, Baton Rouge, La.

Occurrence.—Lower part of Chickasawhay marl. ALABAMA: Station 10050, 1.7 miles southeast of Gainestown on the road to Lambard's Landing, Alabama River (left valve more sharply sculptured, as a rule, than in the usual *C. howei*); stations 7163 and 14520, gully north of old road from Jackson to Walker Springs, about 1 mile north of Glendon (left valve more strongly sculptured, as a rule, than in the usual *C. howei*); station 7166, east bank of Tombigbee River, just south of Payne's Hammock, bed no. 3, Clarke County; station 13392, 4 miles south of Cullomburg on road to Millry, Choctaw County; station 14291, about 1.3 miles north of Millry (typical), Washington County. MISSISSIPPI: Station 14510, Steep Hill Branch, about one-eighth mile from its mouth, SE ¼ sec. 18, T. 8 N., R. 5 W., from bed four to six feet above limestone ledge; station 14509, Bucatunna Creek, about 200 yards below Steep Hill Branch, bed no. 3; station 10053, 4 miles north of Waynesboro on road to Shubuta, near middle of sec. 24, T. 9 N., R. 7 W., bed no. 4; station 13385, one-eighth mile north of Limestone Church, 1½ miles southeast of Boyce; station 14285, bed above "*Chione* limestone," Limestone Creek Church locality, 4 miles north of Waynesboro; station 13386, hill above quarry at mouth of Limestone Creek, 3 miles north-northwest of Waynesboro; station 14286, just east of prisoners' house at State quarry, 3 miles north-northwest of Waynesboro; station 14284, cut in first hill north of Limestone Creek, on new highway, 3 miles north of Waynesboro (rare); station 14283*a*, marl overlying "*Chione* limestone," top of hill on old road leading down to Limestone Creek, 3 miles north of Waynesboro; station 14282, "*Chione* limestone," block of limestone along roadside at Limestone Creek, 3 miles north of Waynesboro; station 14204, lowest bed of blue marl, on Taylor Mill Creek, just

east of highway bridge on Highway 45, 1½ miles north of Waynesboro; stations 14361, 14362, 14515, glauconitic bed near base of section on Chickasawhay River, about one-fourth mile downstream from bridge on Waynesboro-Laurel road, 2½ miles west of Waynesboro, Wayne County.

CHLAMYS (PLAGIOCTENIUM) MCGUIRTI
Mansfield, n. sp.
Plate 26, figures 7, 11

Shell rather small, solid, subcircular; subequilateral. Right valve more inflated than the left; the maximum curvature within the dorsal half of the shell; the left valve compressed in the dorsal region and most convex medially. Costals prominently arched, wider than the intercostals, 21 on the right valve of the cotype; 19 on the left valve, but not of the same individual; those of the right valve flattened on top and inclined to be undercut laterally, the interspaces evenly concave; the costae of the left valve obtusely V-shaped; fortuitous radial striations occasionally developed but no other secondary radial sculpture. Concentric lamination strong and regular in the intercostals, possibly equally strong and regular upon the costals but badly worn upon the ribs of the right cotype; a few heavy resting stages near the outer margin. Submargins narrow, depressed, devoid of ornamentation other than incremental. Auricles rather small, cuneate, the anterior auricle of the right valve decidedly larger than that of the left but with a shallow and inconspicuous byssal sinus; medial part of ears, both on the right valve and the left, finely threaded with about four sharp lirae, overridden by the strong and sharp incrementals. Dorsal margins of right valve incurved slightly. A single pair of low crura subparallel to the dorsal margin. Ligament pit rather large and shallow. Other characters of interior not known.

Syntypes (a right and a left valve of different individuals, U. S. Nat. Mus. 498520, 498521) measure: Right valve: Height, 35.5 mm; width, 36 mm. Left valve: Height, 35.5 mm; width, 35.0 mm. From station 14205, soft marl in gully about one-fourth mile north of Perdue Hill, Monroe County, Alabama.

Chlamys mcguirti differs from *C. howei* in the less circular outline, the more angular ribs, more numerous by two or three, and in the lirate auricles. Although the types of *C. howei* and *C. mcguirti* seem sufficiently distinct to parry confusion, in the long series represented by each of the species, there are variants passing with no perceptible break from one to the other. *Chlamys mcguirti* is the more cosmopolitan type and may be represented in the Flint River faunas of Decatur County, Ga., by some of the forms incorrectly included under *Pecten suwaneënsis* Dall, an Ocala limestone species. *Chlamys mcguirti* does not, however, develop the secondary liration toward the distal extremities that is not uncommon though not typical in *C. howei*, and which is characteristic of a group of upper Oligocene species such as *C. duncanensis* Mansfield, 1934, rather widely distributed in the eastern Gulf. Both *C. howei* and *C. mcguirti* occur at a number of localities in western Alabama and eastern Mississippi, but *C. howei* alone has been recorded from Taylor Mill Creek and only *C. mcguirti* from Perdue Hill.

Specimens from southern Alabama display the broad outline of *C. howei* and the rib count of *C. mcguirti*. Such forms occur commonly at station 6753, old Weaver Chute, two or three miles below McGowan's Bridge, Escambia County, Ala. A single juvenile, possibly referable to *Plagioctenium*, occurs at station 14204, the lower bed of blue marl, Taylor Mill Creek, just east of the bridge on Highway 45, 1½ miles north of Waynesboro, Wayne County, Miss.

An incomplete single valve (U.S.N.M. 166807) from the Flint River formation at station 6159, Decatur County, Ga., more closely resembles *C. howei* in outline and convexity and in the form of the ribs, though it agrees with *C. mcguirti* in the number of ribs.

The specimens from the Suwannee limestone described by Mansfield (1937, p. 214) as species C are juvenile or incomplete, but the relationship to *C. mcguirti* is probably close.

Pecten ceibanus Cooke from the Alazan clay of Mexico is broader and more inflated, with larger auricles. The left valve is not known, but the species presents the outline of true *Pecten*.

Occurrence.—Lower part of the Chicka-

sawhay marl. ALABAMA: Station 14205, soft marl in gully about one-fourth mile north of Perdue Hill, Monroe County; station 14205*a*, overlying ledge in gully about one-fourth mile north of Perdue Hill; station 10334, one-fourth mile northeast of Perdue Hill; station 10050?, road to Lambards Landing, 1.7 miles southeast of Gainestown, Clarke County, Ala., (2 left valves broader and more compressed than *C. mcguirti* but similar in sculpture pattern) station 14322?, uppermost fossiliferous bed on north side of Salt Creek on road from Jackson to Rockville, sec. 34, T. 6 N., R. 2 E. (two poorly preserved specimens, identification in doubt); stations 13381 and 14291, railroad cut and nearby road cut about 1.3 miles north of Millry, Washington County. MISSISSIPPI: station 14288?, southwest corner sec. 8, T. 8 N., R. 5 W., 1 mile north-northeast of Denham, Wayne County, Miss., (fragmentary external molds, determination in doubt); station 14510, Steep Hill Branch about one-eighth mile from its mouth, SE ¼ sec. 18, T. 8 N., R. 5 W., from bed 4 to 6 feet above limestone ledge (a right and a left juvenile valve), Wayne County.

Subgenus AEQUIPÈCTEN Conrad
CHLAMYS (AEQUIPECTEN)
GAINESTOWNENSIS Mansfield, n. sp.
Plate 26, figures 9, 19, 20

Shell rather small for the subgenus; inequilateral; slightly inequivalve, both valves rather feebly convex, but the greatest curvature of the shell higher up toward the dorsal margins in the left valve than in the right, and the right valve more evenly inflated than the left. Valves similarly sculptured with about 19 arched ribs counting those at the margins; the entire disk, both costal and intercostal spaces, threaded with coarse lirae made scabrous by the overriding incrementals; the medial lirations on the rib slightly more prominent than those on either side, and the costal lirations, commonly three in number, slightly more prominent than the three or four in the concave intercostal areas. Submargins rather low, obtusely angulated, prickled at the intersection of the incrementals and the very fine radial threadlets. Auricles rather large, coarsely lirate; with six to ten irregular threads. Byssal notch deep; posterior right auricle and anterior and posterior left auricles cuneate, the width slightly exceeding the height. Dorsal margins of right valve turned inward slightly over the left. Cardinal crura of right valve concealed by the matrix; a single slender pair in the left valve subparallel to the dorsal margin and a second pair obscurely defined and rudely parallel to the margin of the small, subumbonal ligament pit. Character of muscle impression not known, but an unusual number of specimens are preserved as paired valves.

Holotype (U. S. Nat. Mus. 498522, paired valves) measures: Height, 54 mm; width, 52 mm; convexity of double valves, 17.5 mm. Paratype (U. S. Nat. Mus. 498523, a left valve) measures: Height, 51.4 mm; width, 52.0 mm; convexity of single valve, 10 mm. Holotype from station 10050, road to Lambards Landing, 1.7 miles southeast of Gainestown, Clarke County, Ala.; paratype from station 7163, gully north of old road from Jackson to Walker Springs about 1 mile north of Glendon, Clarke County, Ala.

In general form and sculpture pattern *Chlamys gainestownensis* resembles *C. burnetti* Tucker from the Tampa limestone, but the dorsal margins of the Tampa form are more produced and the arc included between them smaller; the primary costals are fewer by two or three, and the secondary liration is relatively coarser. The group is probably continued in *Chlamys acanikos* Gardner of the Chipola formation of Florida and may be represented in *Chlamys* (*Aequipecten*) *canalis* Brown and Pilsbry of the Emperador limestone of the Canal Zone.

Occurrence.—Lower part of Chickasawhay marl. ALABAMA: Station 10050, road to Lambards Landing, 1.7 miles southeast of Gainestown; stations 7163 and 14520, gully north of old road from Jackson to Walker Springs, about 1 mile north of Glendon; station 7165, 200 yards north of Salt Creek, bed no. 5 of section, NW ¼ sec. 34, T. 6 N., R. 2 E., 4½ miles south of Jackson; station 3640?, Payne's Hammock, 10 miles south of Jackson, Clarke County. A poorly preserved but related species in the Chickasawhay marl at station 14322, the uppermost fossiliferous bed on the north side of Salt Creek on the road from Jackson to Rockville, sec. 34, T. 6 N., R. 2 E.

CHLAMYS (AEQUIPECTEN) GLENDONENSIS
Mansfield, n. sp.
Plate 26, figures 15, 21

Shell small, solid, moderately inflated, the left possibly more so than the right; subcircular in outline. Ribs narrow, abruptly elevated, squarish on the adult disk, 21 in number; juvenile costals simple, the secondaries introduced in the adolescent stage, the adult costals threaded with three scaly secondary lirae, with one to three similar threads in the intercostal spaces, the medial secondary commonly stronger than those on either side. Submargins narrow, not angulated at the intersection with the disk, sculptured with about a dozen exceedingly fine, minutely spinose lirae. Ears moderately large; both the right and the left posterior auricles closely threaded with about eight lirations, the anterior auricles, both the right and the left more coarsely threaded with about half a dozen heavy, corrugated lirae; byssal notch shallow; ctenolium not observed.

Holotype (U. S. Nat. Mus. 498524, a right valve) measures: Height, 29.8 mm; width, 31.0 mm; convexity, 6.3 mm. Figured left valve (U. S. Nat. Mus. 498525,) measures: Height, 22.5 mm; width, 21.0 mm; convexity, 5.7 mm. Holotype from station 7163, gully north of road from Jackson to Walker Springs, about 1 mile north of Glendon, Clarke County, Ala. Figured left valve from station 14362, glauconitic bed near base of Chickasawhay River section, about one-fourth mile downstream from bridge on Waynesboro-Laurel road, 2½ miles west of Waynesboro, Wayne County, Miss. The figured left valve is decidedly higher relatively than the right and has not been accepted as a paratype of *C. glendonensis*.

Chlamys glendonensis has much in common with *Chlamys gainestownensis*, and it was for a time considered the young of that species. The shells though they are less than half as large as *C. gainestownensis* present no adolescent characters, and the costals are consistently more numerous by two or three.

Pecten thetidis Cooke, 1919 (not *Pecten thetidis* Sowerby), from Crocus Bay, Anguilla, is a smaller, more evenly inflated disk, with only about 19 ribs, the secondary threading confined for the most part to the tops of the costals; a stronger, concentric imbrication; and more angular submargins.

Occurrence.—Lower part of Chickasawhay marl. ALABAMA: Station 14205, soft marl under ledge in gully, about one-fourth mile northeast of Perdue Hill, Monroe County; stations 7163 and 14520, gully north of the road from Jackson to Walker Springs, about 1 mile north of Glendon; station 14323 highest fossiliferous bed in ravine, 200 yards southwest of Jones plantation house, about 1 mile northwest of Glendon Station, Clarke County; station 13392, road from Cullomburg to Millry, 4 miles south of Cullomburg, Choctaw County; stations 13381 and 14291, railroad cut and adjoining road cut about 1.3 miles north of Millry, Washington County, MISSISSIPPI: station 14284, just north of Limestone Creek on new highway, 3 miles north of Waynesboro; station 13396?, hillside above mouth of Limestone Creek, near middle of sec. 25, T. 9 N., R. 7 W.; station 14281, "*Chione* limestone," Taylor Mill Creek, below bridge on Highway 45, 1½ miles north of Waynesboro; station 14362, glauconitic bed near base of section, Chickasawhay River, one-fourth mile downstream from bridge on Waynesboro-Laurel road, 2½ miles west of Waynesboro, Wayne County.

CHLAMYS (AEQUIPECTEN) WAYNENSIS
Mansfield, n. sp.
Plate 26, figures 17, 18

Shell small, solid, both the right and the left valve inflated, the right more strongly than the left, and the maximum convexity occurring nearer the dorsal margins; ventral and lateral margins evenly rounded. Radial costae, 20 on the right syntype, 18 on the left, strong, even, squarish on the medial portion of the disk, more inclined to be arched toward the ventral margins; intercostals U-shaped with nearly parallel sides; secondary thread developed on the summit on the medial portion of the disk and later with the widening of the rib, a secondary on either side of the medial thread; in the intercostal channels, a single, strong, medial lir-ation developed near the ventral margin with occasional lateral lirae. Concentric imbrications sharp and crowded, looping backward over the primary costals, but with a secondary crenulation at the inter-

section with the secondaries. Submargins narrow, semicrescentic, sculptured only with the incremental laminae. Auricles rather small, the anterior auricle on the right valve moderately produced, threaded with about half a dozen coarse lirae; byssal sinus moderately wide, strongly wrinkled by the incrementals the posterior ear of the right valve and the anterior and posterior ears of the left valve slightly wider than they are high, threaded with six or seven somewhat irregular lirations, much finer than those on the anterior auricle. Ctenolium including a few coarse teeth. Dorsal margins of right valve turned inward; a single pair of cardinal crura produced at a low angle to the margin. Ligament pit small, subumbonal. Muscle scar obliterated. Ventral margins strongly crenulate in harmony with the primary ribbing, the crenae persisting for some little distance from the margin, and the intercostal channels reflected in the form of double ribs similar to those of *Amusium*.

Syntypes (U. S. Nat. Mus. 498526, right, and 498527, left valve, not of the same individual) measure: Right valve: Height, 25.0 mm; width, 25.5 mm; convexity, 7.6 mm. Left valve: Height, 20.2 mm; width, 21.0 mm; convexity, 5.3 mm. From station 13386, hill above quarry at mouth of Limestone Creek, 3 miles northwest of Waynesboro, Wayne County, Miss.

Chlamys (*Aequipecten*) *waynensis* bears both in outline and sculpture pattern a general similarity to *Pecten* (*Aequipecten*) *thetidis* Cooke, not Sowerby, but it differs in the coarser concentric imbrication, the larger auricles and the more sharply defined submargins, which in *waynensis* are devoid of radial sculpture but in *C. thetidis* are finely lineated radially. *Chlamys glendonensis*, also of the lower Chickasawhay, is larger and decidedly less inflated.

Occurrence.—Lower part of Chickasawhay marl. ALABAMA: Station 10334?, one-fourth mile northeast of Perdue Hill, Monroe County (larger and less strongly inflated than type); station 7163?, gully north of road from Jackson to Walker Springs, 1 mile north of Glendon (larger and less evenly inflated than the type); station 10050, road to Lambards Landing, 1.7 miles southeast of Gainestown, Clarke County. MISSISSIPPI: Station 10053, road from Shubuta to Waynesboro near middle of sec. 24, T. 9 N., R. 7 W., 4 miles north of Waynesboro, bed no. 4; station 13385, one-eighth mile north of Limestone Church, 1½ miles southeast of Boyce; station 13386, hill above Quarry at mouth of Limestone Creek, 3 miles northwest of Waynesboro; station 14286, just east of prisoners' house at State Quarry, 3 miles north-northwest of Waynesboro; station 14361, Chickasawhay River section, the glauconitic bed near the base, about one-fourth mile downstream from bridge on Waynesboro-Laurel Highway, 2½ miles west of Waynesboro, Wayne County.

CHLAMYS (AEQUIPECTEN) CHICKARIA
Mansfield, n. sp.
Plate 26, figures 6, 16

Shell of moderate dimensions for the group, not strongly inflated, the right valve slightly less compressed than the left, and the maximum convexity within the dorsal half of the disk. Lateral margins produced, the umbonal angle exceeding a right angle by 10° or 15°. Costals 19 in number on the holotype, strong, simple in the juvenile and possibly the adolescent stages, trisected in the adult by lateral grooves rather than by the development of secondary lirae upon the primaries, a secondary threading developed, however, in the intercostal channels; both costals and intercostals overrun by a fine, sharp, concentric imbrication. Submargins rather narrow, semicrescentic, sculptured only with growth lines and fortuitous radial filaments. Auricles of only moderate dimensions; anterior ear of right valve with a deep sinus, strongly lirate, the dorsal two of the six lirae stronger and more closely spaced than the four in front of them; posterior auricle of right valve and anterior and posterior auricles of left valve decorated with finer and more numerous radials. Dorsal margin of right valve turned inward; a pair of slender cardinal crura subparallel to the dorsal margin in the right valve and ventral to them a second, shorter pair running about midway between the dorsal crura and the raised margins of the trigonal resilifer. Ventral margins deeply crenate, the intercostal channels of the outer surface appearing on the inner surface as *Amusium*-like ribs.

Holotype (U. S. Nat. Mus. 498528, a right valve) measures: Height: 33.0 mm; width,

33.0 mm; convexity, 6.0 mm. From station 14284, highway, just north of Limestone Creek, 3 miles north of Waynesboro, Wayne County, Miss.

The species is remarkable for the incised secondary sculpture on the costals. The immature left valve (U.S.N.M. 498529) shown on plate 26, figure 6, may be the young of *C. chickaria*, but the ribs seem more elevated medially, and the concentric sculpture more imbricated. The height of the specimen is 19.5 mm, the width, 20 mm. Like the holotype, it comes from station 14284.

Occurrence.—Lower part of Chickasawhay marl. Station 14284, highway just north of Limestone Creek, 3 miles north of Waynesboro, Wayne County, Miss.

A right valve 43 mm high and 45 mm wide recovered from the Suwannee limestone at a depth of 55 feet in a well near Thomasville, Ga. (station 10393), may be referable to *Chlamys chickaria*.

CHLAMYS sp. aff. C. DUPLEX (Cooke)
Plate 26, figure 5

Two right valves from the lower part of the Chickasawhay marl at station 10050, 1.7 miles southeast of Gainestown, Clarke County, Ala., recall *Pecten* (*Patinopecten*) *duplex* Cooke (1919, p. 140, pl. 11, figs.10 a, b) in the narrow, squarish, medially sulcate ribs. The type of *duplex* is a badly damaged pair of valves in an indurated matrix. The left valve is compressed, the right is feebly inflated, much more feebly than in the Alabama species here figured. The ornamentation in the two forms is similar in general character, although the ribs in the Anguilla species number 19 instead of 21 as in the Chickasawhay form. The submargins are wider in the Alabama individuals, but the auricles are not so wide and show more evidence of radial liration. The figured individual (U.S.N.M. 498530) is 38 mm in height, and the width, before the breaking of the posterior lateral margin, probably exceeded the height.

CHLAMYS sp.
Plate 26, figure 2

Juveniles characterized by a low rib count, 16 in the figured specimen, do not conform to any recognized species. The lateral margins are more sloping than in the majority of the Chickasawhay Pectens, and the angle between them exceeds a right angle by less than 10°. The ribs in the umbonal region are simple, sharply defined, and strongly and smoothly arched; a medial thread, rendered minutely spinose by the overriding incrementals, is developed a short distance from the umbones and, later, lateral threads. In an individual slightly older than that figured, a medial secondary is developed in the intercostal channel. The ventral margin is evenly crenulated by the primaries. The submargins are relatively wide, semicrescentic, microscopically lineated radially, or smooth excepting for incrementals. The auricles of the left valve, the only valve known, are moderately large, a little wider than high, and threaded with about half a dozen scabrous lirae.

The figured left valve (U.S.N.M. 498531), a juvenile, is 24 mm high and 23.5 mm wide. It is from station 14510, Steep Hill Branch, about one-eighth mile from its mouth in the SE ¼ sec. 18, T. 8 N., R. 5 W., Wayne County, Miss. from a bed 4 to 6 feet above the limestone ledge. No similar juveniles have been found elsewhere.

The species is higher than either *Chlamys howei* or *C. mcguirti* and differs from both in the regular development of a radial sculpture. The early primaries are less angular than those of *C. gainestownensis*, and the secondaries are developed in a different manner and order of succession; the costals in *C. glendonensis* are more numerous and differ in form and secondary ornamentation; in *C. waynensis*, the shell is lower and more inflated medially, and the costals more angular; in *C. chickaria*, the secondary sculpture is developed by the longitudinal grooving of the primaries. The form of *Chlamys* sp. resembles that of *C. thetidis* Cooke, but the concentric sculpture is much less strong.

Only three left valves, all of them immature, have been found.

Genus ANOMIA Linnaeus

ANOMIA TAYLORENSIS Mansfield, n. sp.
Plate 25, figures 13, 14

Shell very thin and fragile, lustrous, somewhat greenish; of moderate size; the left valve inflated in the umbonal area.

Sculpture of crude plications irregular in form and arrangement. Margin of left valve incurved and thickened slightly. Ligament scar narrow, crescentic, symmetrically placed high up beneath the left umbone. The two byssal scars and the adductor scars included within the chalky, dorsoventrally produced area on the medial, dorsal portion of the interior, the dorsal extremity of the scarred area near the ligament scar but not in contact with it, the ventral extremity near the median horizontal. Major byssal scar the most dorsal of the three, subcircular, the minor byssal scar also subcircular, slightly smaller than the major scar but almost in line with it. The adductor scar, intermediate in size between the byssal scars and posterior to them in position. Right valve not known.

Holotype (U. S. Nat. Mus. 498532) with imperfect ventral margin measures: Height: 38 mm (estimated); width, 36 mm; convexity, 9.5 mm. Paratype (U. S. Nat. Mus. 498533) measures: Height, 22.5 mm; width, 20.0 mm. From station 14204, Taylor Mill Creek, lower blue marl, just east of bridge on Highway 45, 1½ miles north of Waynesboro, Wayne County, Miss.

Although there are comparatively few records of *Anomia* in the Gulf Oligocene in western Alabama and eastern Mississippi in the lower part of the Chickasawhay marl, *A. taylorensis* is widespread and far from rare. Like most of the genus, it varies widely in outline. The holotype is by no means the largest of the individuals that represent the species in the Museum collections. A height of 45 mm is not at all uncommon. The degree of convexity is also variable. The holotype is of average inflation, but the paratype is more highly and more evenly convex than the majority of individuals. Many of the valves show no sculpture whatever, and an irregular wrinkling of the shell is commonly developed only at the ventral margin. In specimens from the higher Chickasawhay the radial sculpture seems a constant factor, and this difference should probably be recognized in the taxonomy.

Anomia microgrammata Dall and *A. glypta* Gardner from the Chipola formation are finely lineated radially. *Anomia suwanneensis* Gardner from the Hawthorn formation at White Springs on the Suwannee River in Hamilton County, Fla., is a larger, heavier shell with the scars in the left valve not so close to the dorsal margin as they are in *A. taylorensis*. It seems, however, to be closer to the Chickasawhay form than any other of the described species.

Occurrence.—Lower part of the Chickasawhay marl. ALABAMA: Station 14205, soft marl under ledge in gully about one-quarter of a mile north of Perdue Hill; station 10334, one-quarter of a mile northeast of Perdue Hill, Monroe County; station 14323, highest fossiliferous bed in ravine 200 yards south-southwest of Jones' old plantation house, about 1 mile northwest of Glendon Station, Clarke County; station 13381, 1.3 miles north of Millry, Washington County. MISSISSIPPI: Station 10053, road from Shubuta to Waynesboro, near middle of sec. 24, T. 9 N., R. 7 W., bed no. 4, 4 miles north of Waynesboro, Wayne County; station 14510, Steep Hill Branch about one-eighth of a mile above its mouth, SE ¼ sec. 18, T. 8 N., R. 5 W.; station 14285, bed above "*Chione* limestone," Limestone Creek Church locality, 4 miles north of Waynesboro; station 13385, one-eighth of a mile north of Limestone Church, 1½ miles southeast of Boyce; station 13386, hill above quarry at mouth of Limestone Creek, 3 miles northwest of Waynesboro; station 13396, hillside above mouth of Limestone Creek, near middle of sec. 25, T. 9 N., R. 7 W.; station 14286, east of prisoners' house at State Quarry, 3 miles north-northwest of Waynesboro; station 14283*a*, highest fossiliferous bed, at top of hill on old road leading down to Limestone Creek, 3 miles north of Waynesboro; station 14204, Taylor Mill Creek, the lower bed of blue marl, just east of bridge on Highway 45, 1½ miles north of Waynesboro; station 14281, "*Chione* limestone "overlying blue marl on Taylor Mill Creek, 1½ miles north of Waynesboro; stations 14349, 14362, 14515, glauconitic bed near base of Chickasawhay River section, about one-fourth of a mile downstream from bridge on Waynesboro-Laurel highway, 2½ miles west of Waynesboro, bed no. 4; station 14363, above glauconitic bed of the Chickasawhay River section; station 14345, Sandy Creek, sec. 34. T. 9 N., R. 7 W., Wayne County.

A closely allied form differing in the stronger radial sculpture is included in col-

lections from the upper part of the Chickasawhay marl at the following localities: ALABAMA: Station 11088, Choctaw Bluff, on the Alabama River, sec. 27, T. 5 N., R. 3 E., Clarke County. MISSISSIPPI: Station 14350, near the top of the Chickasawhay River section, about one-fourth of a mile downstream from bridge on Waynesboro-Laurel highway, 2½ miles west of Waynesboro; station 14289, near the top of the Chickasawhay River section; station 14287, waterfall on Patton Creek, one-quarter of a mile above Highway 45, 1½ miles east of Waynesboro, Wayne County.

Genus OSTREA Linnaeus

OSTREA VICKSBURGENSIS Conrad

Ostrea vicksburgensis CONRAD, *1848*, Acad. Nat. Sci. Philadelphia, Jour., 2d ser., vol. 1, p. 126, pl. 13, figs. 5, 37.

Plicated; very irregular and adhering, the upper valve not flat, but swelling in an irregular manner. Height 1¾ [inches]. CONRAD, 1848.

Although Conrad's description of *O. vicksburgensis* is short and his illustrations poor, specimens from the Byram marl at Vicksburg, Miss., have been determined with assurance under his name.

Ostrea vicksburgensis is a relatively small, thin species, commonly rather broad and lopsided, with perhaps a dozen strong, sharp plicae on the attached right valve, and fewer and feebler folds on the left. There is a certain increase in the number of folds by anastamosing and intercalation. The major folds on the right valve usually spring from the umbones; those of the left valve have a later origin. The lower valve is a little deeper than the upper and tends to develop fewer and more spinose ribs. The margins are fluted in some individuals, some much more strongly than in others.

The species is widespread in the upper Oligocene of the Gulf from the Flint River formation of Georgia to northeastern Mexico.

Occurrence.—Lower part of Chickasawhay marl. ALABAMA: Station 6749, McGowan's Bridge, west bank of Conecuh River, about 1 mile below the mouth of Sepulga River, Escambia County; station 14205, soft marl under ledge in gully about one-fourth mile north of Perdue Hill, Monroe County; station 13392, on road from Columburg to Millry, 4 miles south of Collumburg, Choctaw County; station 13381, 14291 railroad cut and adjoining road cut, about 1.3 miles north of Millry, Washington County. MISSISSIPPI: Station 10053, 4 miles north of Waynesboro on road to Shubuta, bed no. 4, Wayne County; station 13385, one-eighth mile north of Limestone Church, 1½ miles southeast of Boyce; station 14285, bed above "*Chione* limestone," Limestone Creek Church locality, 4 miles north of Waynesboro; station 14513*a*, Limestone Creek church, directly below upper ledge; station 14283*a*, from marl overlying "*Chione* limestone," at top of hill on old road leading down to Limestone Creek, 3 miles north of Waynesboro; station 14284, just north of Limestone Creek, on new highway 3 miles north of Waynesboro; station 13386, hill above quarry at mouth of Limestone Creek, 3 miles northwest of Waynesboro; station 14286, just east of prisoners' house at State Quarry, 3 miles north-northwest of Waynesboro; station 6648, Chickasawhay River, one-fourth mile west of Woodward and 2 miles northwest of Waynesboro; station 14204, Taylor Mill Creek, just east of highway bridge, 1½ miles north of Waynesboro; station 14362, Chickasawhay River section, 2½ miles west of Waynesboro, bed no. 4.

Upper part of Chickasawhay marl. MISSISSIPPI: Station 14350?, Chickasawhay River 2½ miles west of Waynesboro, (fragments only); station 14365?, the same section, bed no. 8 (worn fragments only); station 14289?, the same section, bed no. 9 (thin and worn fragments, possibly reworked); station 13388, one-fourth mile above wagon bridge, 2½ miles south of Waynesboro, Wayne County, reworked?

OSTREA sp. indet.

Massive *Ostrea* recalling *O. normalis* Dall, 1898, and *O. vaughani* Dall, 1915, in their general dimensions and weight but probably distinct from both of them occur at station 10334, the lower part of the Chickasawhay marl, one-fourth mile northeast of Perdue Hill, Monroe County, and at station 7165, bed no. 5, in the bluff east of the Jackson-Rockville road, 200 yards north of Salt Creek, 4½ miles south of Jackson, Clarke County, Ala. This may be the species in-

correctly determined as *Ostrea mauricensis* Gabb (Dall, 1916). Dall reported Gabb's species from station 3400, 8 miles southeast of Bainbridge, Decatur County, Ga.

OSTREA sp. cf. O. ANTIGUENSIS Brown

A corroded left valve from station 7163, the gully north of the road from Jackson to Walker Springs, 1 mile north of Glendon, Clarke County, Ala., is comparable in size to *Ostrea antiguensis* Brown, from the Antigua formation of the Island of Antigua. There are also traces on it of plications resembling those of *O. antiguensis*, but the material is much too incomplete to be determined. *Ostrea antiguensis* is rather widespread in the upper Oligocene of Antigua and is recorded from Puerto Rico.

OSTREA BLANPIEDI Howe

Ostrea blanpiedi HOWE, *1937*, Jour. Paleontology, vol. 11, no. 4, p. 362, pl. 44, figs. 1–4.

The type locality of *Ostrea blanpiedi* is a small stream gully one-eighth of a mile northwest of the type locality of the upper Chickasawhay, in the NW ¼ sec. 10, T. 8 N., R. 7 W., Wayne County, Miss. The species is locally of reef-making abundance and is recorded by Howe from upper Chickasawhay faunas as far west as Leaf River, Smith County, Miss. He also reports the species from western Alabama, from Choctaw Bluff on the Alabama River in Clarke County. The specimens from station 11088, Choctaw Bluff, in the collections of the U. S. National Museum are much less heavy than *Ostrea blanpiedi* from the type locality. They and similar forms from station 3640, Payne's Hammock on the Tombigbee River, 10 miles south of Jackson, may be taxonomically distinct from the *Ostrea blanpiedi* of Wayne County.

Occurrence.—Upper part of Chickasawhay marl. MISSISSIPPI: Station 14287, waterfall on Patton Creek, one-fourth mile above Highway 45, 1½ miles east of Waynesboro; stations 14289, 14351, 13238, NW ¼ NW ¼ sec. 25, T. 8 N., R. 7 W., Chickasawhay River, elevation 126, Wayne County.

Genus PERIPLOMA Schumacher

PERIPLOMA sp.

Specifically indeterminate molds, some of them with fragments of a thin, subnacreous shell adhering, are locally common in the Chickasawhay of eastern Mississippi. It is probable that more than a single species is represented. Fragments of a thin, concentrically wrinkled shell are retained on the two molds from the lower Chickasawhay at station 14204, the lower blue marl just east of the bridge over Taylor Mill Creek on Highway 45, 1½ miles north of Waynesboro, Miss. The height of the larger mold is about 28 mm, the width about 34 mm. The diagnostic spoon is retained on the smaller individual. A form similar in outline but represented only by internal molds occurs at station 14516, in the glauconitic greensand near the base of the Chickasawhay River section. The section is about a quarter of a mile downstream from the bridge on the Waynesboro-Laurel road, 2½ miles west of Waynesboro. The internal molds at the top of the Chickasawhay at station 13388, 2½ miles south of Waynesboro, Miss., probably represent a second species, They run larger than the specimens from the lower Chickasawhay, between 35 and 40 mm in height and between 40 and 45 mm in width. The medial inflation of the valves is rather marked, but they are compressed toward the ventral and lateral margins and present a somewhat warped aspect. Traces of the former presence of a clavicular rib and of a chondrophore are discernible.

The genus has a meagre representation in the mid-Tertiary of the East Coast and Gulf. *Periploma peralta* Conrad from the St. Marys formation of Maryland and *Periploma gardneri* Soot-ryen from the Shoal River, and the lower Choctawhatchee formations of Florida are almost double the size of the Chickasawhay forms. An undescribed Vicksburg species is about the same size as those from the Chickasawhay but is relatively wider.

Genus THRACIA (Leach Ms.) de Blainville

Subgenus CYATHODONTA Conrad

THRACIA (CYATHODONTA) TAYLORENSIS Mansfield, n. sp.

Plate 25, figure 39

Species known from three damaged right valves from a single locality. Shell small, very thin and brittle, transversely ovate in outline. Umbones rather low and apparently flattened, subcentral. Anterior part of

shell broadly and evenly rounded, the posterior contracted and subtruncate, depressed slightly behind the rostrum and elevated at the oblique dorsal margin. Rostrum obtuse, clearly marked at the umbones, flattening ventrally, defined, however, not only by the contour of the shell but also by the abrupt change in the character of the sculpture. Low, evenly undulating ripples on the disk and anterior portion of the shell, abruptly replaced on the rostrum by much finer, irregular concentric wrinkles; both the ripples and the spaces between them concentrically striated; the area behind the rostrum obscurely granulated. Characters of interior not known.

Holotype (U. S. Nat. Mus. 498535, a right valve) measures: Height, 16 mm; width, 22 mm. From the lower part of the Chickasawhay marl at station 14204, the lower bed of blue marl, just east of the bridge on Taylor Mill Creek, on Highway 45, 1½ miles north of Waynesboro, Miss.

Thracia (*Cyathodonta*) *vicksburgiana* Dall from Vicksburg, Miss., is larger, more produced anteriorly, and more strongly sculptured concentrically. The *Thracia?* sp. from station 12723, the A. L. Parrish farm, 3½ miles southeast of Wausau, Washington County, Fla., to which reference was made by Mansfield, 1933, resembles *T. vicksburgiana* in size and sculpture pattern. The subspecies *Thracia vicksburgiana hernandoensis* Mansfield, 1937, is even larger than the Vicksburg form. *Thracia* (*Cyathodonta*) *gatunensis* Toula, 1908, from the Canal Zone, and Dall's closely related if not identical *Cyathodonta guadalupensis* and *C. spenceri* from the Island of Guadaloupe are all strongly and evenly rippled concentrically.

The Recent *Cyathodonta* are widely distributed in the warmer waters.

Genus CRASSATELLITES Krüger

CRASSATELLITES PARAMESUS Dall

Crassatellites paramesus DALL, *1916*, U. S. Nat. Mus., Proc., vol. 51, p. 495, pl. 85, figs. 4, 5, 7, 8.

The holotype and paratype are from station 7096, at Red Bluff, on the west bank of the Flint River, 7 miles above Bainbridge, Decatur County, Ga. Additional specimens were collected from the Flint River formation at station 7131, at Cherry Chute on the Flint River, 2¾ miles below Bainbridge, and at station 2311, Hawkinsville, Pulaski County, Ga.

Like *Crassatellites mississippiensis* Conrad from the Byram marl at Vicksburg, Miss., and *C. deformis* (Heilprin) of the Tampa limestone, *Crassatellites paramesus* is a heavy, subovate shell, with flattened umbones. The sculpture on the umbones is coarser in *C. paramesus* than in *C. mississippiensis*, not so coarse as in *C. deformis* (Heilprin). In the degree of development and persistence of the concentric sculpture on the disk, *C. paramesus* is intermediate between the Vicksburg species characterized by a sculpture that is restricted largely to the umbones and the lateral areas, and the Tampa limestone form in which a strong and fairly regular sculpture persists from the anterior margin across the disk to the posterior keel.

The height of the incomplete paratype, a left valve (U.S.N.M. 166715), is 27 mm. The squeeze of an incomplete right valve (U.S.N.M. 498536) may represent a shell half again as large. The mold from which it was made was collected from the Chickasawhay marl at station 14283, the "*Chione* limestone" at the top of the hill leading down to Limestone Creek, 3 miles north of Waynesboro, Miss.

There is a common but very poorly preserved form at station 14287, the waterfall on Patton Creek, one-fourth mile above Highway 45, and 1½ miles east of Waynesboro. It cannot be determined with assurance, but the coarse, concentric rippling seems to occupy a larger area on the disk than it does in the usual C. *paramesus*.

Occurrence.—Lower part of Chichasawhay marl. ALABAMA: Station 14293, east side of Conecuh River at Weaver's Chute, sec. 18, T. 2 N., R. 13 E., Escambia County; station 14205*a*, gully about one-fourth of a mile north of Perdue Hill, Monroe County; station 14291, railroad and adjoining road cut, about 1.3 miles north of Millry, Washington County. MISSISSIPPI: Station 14519, old road on east side of new road south of Limestone Creek, about halfway up the hill; station 14283, "*Chione* limestone" at top of hill on old road leading down to Limestone Creek, 3 miles north of Waynes-

boro; station 14282, "*Chione* limestone" blocks along roadside, probable fallen from station 14283; station 14281, "*Chione* limestone," Taylor Mill Creek, 1½ miles north of Waynesboro, just east of bridge on Highway 45, Wayne County.

Genus CRASSINELLA Guppy
CRASSINELLA sp.
Plates 25, figures 16, 17

Two fragile left valves (U.S.N.M. 498537) not sufficiently preserved to constitute types were recovered from the lower part of the Chickasawhay marl at station 14204, the lower bed east of the bridge over Taylor Creek, 1½ miles north of Waynesboro on Highway 45. They are compressed, trigonal, little forms less than 3 mm high, ornamented with fine, concentric lirae, about seven in all and evenly spaced from the tip of the beaks to the ventral margin. These shells may well represent an undescribed species allied to undescribed specimens from the Byram marl at Vicksburg. The Vicksburg shells are of a similar size and shape, but the concentric ornamentation is less regular and more delicate and laminated.

Genus VENERICARDIA Lamarck
"VENERICARDIA" WAYNENSIS
Mansfield, n. sp.
Plate 25, figures 9, 10, 18

Shell small for the group, relatively thin, obliquely ovate in outline. Umbones full, prominent, the tips turned inward and forward, anterior in position. Lunule short, broad, incised, semicordate in the single valve. Escutcheon not defined. Anterior margin broadly rounded in front of the lunule, merging smoothly into the upcurved ventral margin; posterior lateral margin obtusely truncate, the posterior area obscurely defined by the change in the contour of the shell and the lesser elevation of the costals. Ribs 18 to 19 in number, high, strong, weakly undercut laterally, not quite so wide as the interspaces, obtusely serrated by growth lamellae; ribs on the posterior slope only a little less elevated than the medial and anterior costals, except for the fourth from the margin, which is a little weaker than those on either side; secondary sculpture in the form of a radial thread developed in the adult at the base of each rib. Dentition preserved in a few individuals. In the right valve, a very short, platy anterior cardinal, parallel to the lunular margin and grooved on the inner face, and a heavy, much produced, and feebly arcuate medial cardinal grooved on the dorsal face and produced parallel to the ligament groove, the posterior cardinal fused with the margin of the ligament groove; a pustule analogous to the posterior lateral at the extremity of the groove. In the left valve, a peglike anterior cardinal, flattened transversely and grooved on its dorsal face; and a slender, much produced posterior cardinal. A pustular anterior lateral at the extremity of the sulcus outlining the lunule, and a faint dimple in line with the ligament groove for the reception of the incipient posterior lateral. Adductor scars and simple pallial line distinct on fresh individuals. Interior margins with shallow flutings, some of them traceable, faintly, to the umbones.

Holotype (U. S. Nat. Mus. 498538, a left valve) measures: Height, 21.0 mm; width, 23.0 mm. Paratype (U. S. Nat. Mus. 498539, an incomplete left valve) measures: Height, 17.5 mm; width, 19 mm. Holotype from station 14204, lower bed just east of bridge over Taylor Mill Creek, on Highway 45, 1½ miles north of Waynesboro, Miss. Paratype from station 14205, in soft marl underlying ledge in gully about one-fourth of a mile north of Perdue Hill, Monroe County, Ala.

The character of the dentition excludes this shell from *Venericardia* s.s. "*Venericardia*" *serricosta* (Heilprin) is roughly similar in general form and sculpture, but the Tampa species is more inflated, the posterior area more clearly defined, the primaries a little more elevated, and the transverse beading on the tops of the primaries sharper. The subspecies in the Suwannee at Brooksville, Hernando County, Fla., may differ from "*V.*" *waynensis* in the more uniform sculpture on the posterior slope, but the two forms are very close indeed. The Suwannee species was described from incomplete, external molds. The species cited by Dall, 1916, in his report on the Flint River fauna under the name of *Cardita* (*Carditamera*) *shepardi* Dall is not the same as that which he described from the Tampa limestone in

1915, but a form very close to and possibly identical with "*Venericardia*" *waynensis*. *Venericardia* sp., Mansfield, 1938, from the A. L. Parrish farm, Washington County, Fla., is also a member of this compact group, widespread in the eastern Gulf in the late Oligocene. The race was probably continued through *Venericardia serricostata* Heilprin of the Tampa limestone into *Venericardia hadra* Dall and *V. himerta* Dall of the Alum Bluff group of Florida.

Occurrence.—Lower part of Chickasawhay marl. ALABAMA: Station 14205, in soft marl underlying ledge in gully about one-fourth of a mile north of Perdue Hill; station 10334, one-fourth of a mile northeast of Perdue Hill, Monroe County; station 14323, highest fossiliferous bed in ravine, 200 yards south-southwest of Jones' old plantation house, about 1 mile northwest of Glendon Station; stations 3640 and 7166, Tombigbee River, just south of Payne's Hammock, 10 miles south of Jackson; station 7165?, bluff east of Jackson-Rockville road, 200 yards north of Salt Creek, no. 5 of section, 4½ miles south of Jackson, Clarke County. MISSISSIPPI: Station 13239?, NW ¼ sec. 17, T. 8 N., R. 5 W., Bucatunna Creek locality; station 13396, hillside above mouth of Limestone Creek, near middle of section 25, T. 9 N., R. 7 W.; station 14286, just east of prisoners' house at State Quarry, 3 miles north-northwest of Waynesboro; station 14204, Taylor Mill Creek, just east of bridge on Highway 45, 1½ miles north of Waynesboro; station 14349, greensand bed of Chickasawhay River section, one-fourth mile downstream from bridge on Waynesboro-Laurel highway, 2½ miles west of Waynesboro, Wayne County.

"VENERICARDIA" sp.

Specifically indeterminate internal and external molds related in a general way to "*Venericardia*" *waynensis* Mansfield are common at station 14364, near the top of the Chickasawhay River section, one-fourth of a mile below the bridge on the Waynesboro-Laurel Highway, 2½ miles west of Waynesboro, Wayne County, Miss. They indicate a transversely elongate shell similar in form and dimensions to "*V.*" *waynensis* and "*Venericardia*" *serricosta* (Heilprin), abundant in the Tampa limestone. The ribs, however, are grooved on either side of the beaded medial crest, giving a tripartite aspect to the costals. The flattening of the shell during the process of fossilization has probably exaggerated this effect.

The matrix is an indurated argillaceous sandstone with clear angular quartzes and pockets of loose sand and glauconite.

Genus CHAMA Linnaeus or Genus PSEUDOCHAMA Odhner

From the molds alone it is impossible to differentiate between *Chama* which is attached by the right valve and *Pseudochama* which is attached by the left.

Molds similar to *Chama* or *Pseudochama* sp. A, Mansfield, 1937, occur in the lower part of the Chickasawhay marl at the following localities: ALABAMA: Station 10334, one-fourth of a mile northeast of Perdue Hill, Monroe County. MISSISSIPPI: Station 14283, "*Chione* limestone" on top of hill on old road leading down to Limestone Creek, 3 miles north of Waynesboro; station 14282, blocks of "*Chione* limestone" along roadside, probably fallen down from station 14283.

Genus ANODONTIA Link ANODONTIA sp.

Specifically indeterminate internal molds of paired valves are common at a few localities in the higher Chickasawhay. In form and dimensions they are similar to *Lucina corpulenta* Dall, 1903, from the Chipola formation of Florida. Comparable molds are common at a number of localities in the Tampa limestone of Florida, but they run larger. An average mold from the upper Chickasawhay measures 35 mm in height, 37 mm in width, and 27 mm in diameter. The size is conspicuously uniform. No juveniles have been observed, and the largest mold noted was 45 mm high. Among the Tampa Anodontias there is one over 70 mm in height and many small, presumably immature individuals. More than one species of *Anodontia* may be represented in that assemblage, and there are many specimens which, in the few characters preserved, are identical with these from the upper Chickasawhay. Nothing of the sort has been recognized in the Suwannee limestone,

the Flint River formation, or the Byram marl. The genus is present, however, in the middle Eocene faunas of the Gulf province and probably continued to exist during the Oligocene.

Occurrence.—ALABAMA: Station 11088, Choctaw Bluff, Alabama River, Clarke County. MISSISSIPPI: Station 14285, bed above "*Chione* limestone," Limestone Creek Church locality, 4 miles north of Waynesboro; station 13241, center of sec. 18, T. 8 N., R. 5 W., Rocky Creek locality (1 specimen); station 14508, Bucatunna Creek, about 200 yards below Steep Hill Branch, SE ¼ sec. 18, T. 8. N., R. 5 W., bed no. 3 (1 specimen); station 14508*a*, bed no. 4 of the section at station 14508 (3 specimens); station 14289, near top of Chickasawhay River section, one-fourth of a mile downstream from bridge on Waynesboro-Laurel Highway, 2½ miles west of Waynesboro (very abundant); station 13237, NE ¼ SW ¼ sec. 10, T. 8 N., R. 7 W., elevation 140 to 145 feet; station 13238, NW ¼ NW ¼ sec. 25, T. 8 N., R. 7 W., oyster bed, elevation 126 feet, Wayne County.

Genus MYRTAEA Turton
Section MYRTAEA s.s.
MYRTAEA (MYRTAEA) TAYLORENSIS
Mansfield, n. sp.
Plate 25, figures 20, 21

Shell of moderate dimensions, thin, equivalve, subequilateral, and moderately inflated. Squarish in outline; the dorsal margins oblique and gently sloping; both the anterior and posterior margins truncate, the posterior more produced and not so close to the vertical as the anterior; ventral margin broadly and evenly arcuate. Lunule and escutcheon long, narrow, depressed, defined by an incised groove. Both the anterior and posterior areas depressed and defined, the anterior the more sharply. Surface crowded with moderately fine concentric lamellae, the edges more upright on the lateral areas and weakly spinose at the margins. Ligament groove narrow, produced about three-fourths of the length of the dorsal margin. A single, short, oblique, bifid cardinal tooth in the right valve; short, double sockets near the distal extremities to receive the bevelled margins of the lunule and escutcheon of the opposite valve. Two short, divergent laminar cardinals in the left valve; the margins of the lunule and escutcheon functioning as laterals. Interior feebly rayed. The anterior and posterior adductor scars distinct, the posterior the larger, both of them rudely elliptical in outline. Pallial line simple. Inner margins somewhat thickened, smooth.

Syntypes (U. S. Nat. Mus. 498540) measure: Right valve: Height, 9.0 mm; width 9.4 mm; convexity, 2.3 mm. Left valve of different individual: Height, 7.9 mm; width, 8.0 mm; convexity, 2.1 mm. From station 14204, lower bed of blue marl, just east of bridge on Highway 45, 1½ miles north of Waynesboro, Wayne County, Miss.

Lucina vicksburgensis Casey from the Mint Spring marl member of the Marianna limestone is a less finely and sharply sculptured little shell, and the lunule is shorter and deeper than that of *Myrtaea taylorensis*. *Myrtaea limoniana* Dall, 1903, described from the Bowden marl, is broadly similar in size and sculpture pattern, but it is less angular in outline.

In America *Myrtaea* is first recognized in the Eocene and continues through the middle and later Tertiary to the Recent and is living today in temperate and tropical seas.

Myrtaea (*Myrtaea*) *taylorensis* is common at the type locality, but it has not been found elsewhere.

Genus MILTHA H. and A. Adams
MILTHA sp. cf. M. CHIPOLANA Dall
Plate 25, figure 23

Phacoides (*Miltha*) cf. *P. chipolana* Dall. MANSFIELD, *1938*, Washington Acad. Sci., Jour., vol. 28, no.3, p. 104, fig. 10.

Poorly preserved but apparently closely related fragments of *Miltha* have been recovered from a number of localities in the upper Oligocene from Florida to western Alabama. They have much in common with *Phacoides* (*Miltha*) *chipolanus* Dall from the Chipola and Oak Grove formations but seem slightly more elevated in the umbonal area. The form cited in 1938 was from the Suwannee limestone at station 12723, on the A. L. Parrish farm, 3½ miles southeast of Wausau, Washington County, Fla. An external mold also from the Suwannee

limestone from station 12317, 10.2 miles northwest of Brooksville, Hernando County, Fla., may be conspecific. Incomplete shells which are not separable from the Suwannee molds occur in the lower Chickasawhay at station 14205 in the soft marl directly beneath the ledge in a gully one-fourth of a mile north of Perdue Hill, Monroe County, Ala. A fragment of a right valve (U.S.N.M. 498541) showing the characteristic dorsal area is figured.

MILTHA sp. cf. M. HILLSBOROENSIS (Heilprin)

The holotype of *Miltha hillsboroensis* (Heilprin) is a Tampa limestone shell. The species was recorded from the Flint River formation of Georgia by Dall, 1916, and at a number of localities in the Suwannee limestone of Florida by Mansfield, 1937. Poorly preserved molds in the lower Chickasawhay are probably conspecific. Such molds have been found at the following localities: ALABAMA: Station 7165, bed no. 5, bluff east of the Jackson-Rockville road, 200 yards north of Salt Creek, 4½ miles south of Jackson; station 7166, east bank of Tombigbee River, just south of Payne's Hammock, Clarke County. MISSISSIPPI: Station 13386, hill above quarry at mouth of Limestone Creek, 3 miles northwest of Waynesboro; station 14282, blocks of "*Chione* limestone" along side road of Limestone Creek, 3 miles north of Waynesboro; station 14519, old road, east side of new road, south of Limestone Creek, about halfway up the hill; station 14349, glauconitic bed near base of Chickasawhay River section, one-fourth mile downstream from bridge on Waynesboro-Laurel road, 2½ miles west of Waynesboro, Wayne County.

MILTHA? HERNANDOENSIS Mansfield
Plate 25, figure 35

Phacoides (*Miltha?*) *hernandoensis* MANSFIELD, *1937*, Florida Geol. Survey, Bull. 15, p. 245, pl. 17, figs. 2, 7.

The syntypes of *Miltha? hernandoensis* Mansfield are from the Suwannee limestone at station 12758, Camp Concrete rock quarry, 5.9 miles northeast of Brooksville, Hernando County, Fla. An external mold of a left valve (U.S.N.M. 498542) collected from the lower part of the Chickasawhay marl agrees with the Suwannee species in all the characters revealed. The Chickasawhay locality is station 14519, an old road leading down to Limestone Creek, from a bed about halfway up the hill and about 3 miles north of Waynesboro, Wayne County, Miss.

Genus DIVARICELLA von Martens
DIVARICELLA sp.
Plate 25, figure 33

Two valves of the genus *Divaricella* have been taken from stations near Perdue Hill, Monroe County, Ala.; the figured specimen from station 10334, the limestone ledge one-fourth mile northeast of Perdue Hill, and another from station 14205, the bluish gray marl beneath the ledge one-fourth mile north of Perdue Hill. They do not agree specifically with any described species. Indeed, except for *Lucina* (*Cyclas*) *subrigaultiana* Meyer, 1886, a larger and less inflated shell from the "Lower Vicksburgian" at Vicksburg, Miss., no Divaricellas have been described from the Oligocene of the East Coast and Gulf provinces. There is, however, an undescribed species recorded by Mansfield, 1937, in the Suwannee limestone at station 12758, about 5 miles northeast of Brooksville, Hernando County, and a similar form at station 12723, the upper bed on the H. L. Parrish place, 3½ miles southeast of Wausau. The specimens from Perdue Hill seem identical with that from Brooksville, but both the Perdue Hill and Brooksville individuals seem more coarsely sculptured than that from Wausau. *Divaricella chipolana* Dall, 1903, is larger and less convex than the Suwannee species and superficially less closely allied than *Divaricella waltoniana* Gardner, 1926, of the later Shoal River fauna.

The figured squeeze of an external mold of a left valve, U.S.N.M. 498543, is 10–11 mm high and 11–12 mm wide.

Genus DIPLODONTA Bronn
DIPLODONTA sp. cf. D. ALTA ANCLOTENSIS Mansfield
Plate 25, figure 15

The holotype of *Diplodonta alta anclotensis* Mansfield is from the Tampa limestone at Tarpon Springs, Fla. An internal

mold of paired valves, (U.S.N.M. 498544) similar in a general way but more narrow and produced anteriorly were taken from the lower part of the Chickasawhay marl at station 14281, the "*Chione* limestone" below the bridge at Taylor Mill Creek, on Highway 45, 1½ miles north of Waynesboro, Wayne County, Miss. Less inflated forms more closely resembling *Diplodonta alta* Dall, also from the Tampa limestone, occur at stations 14204, the lower bed of blue marl below the "*Chione* limestone" of station 14281, and at station 14205, in the soft marl under the limestone ledge in the gully one-fourth mile north of Perdue Hill, Monroe County, Ala. Molds indicating possibly a related species occur in the upper Chickasawhay at station 14287, at the waterfall on Patton Creek, one-fourth mile above Highway 45, 1½ miles east of Waynesboro.

The height of the figured mold is 18.5 mm; the width, 20.0 mm; the diameter, 13.0 mm.

Subgenus SPHAERELLA Conrad

DIPLODONTA (SPHAERELLA?) WAYNENSIS Mansfield, n. sp.

Plate 25, figure 12

Shell small, rounded, strongly inflated, equivalve and nearly equilateral. Umbones gibbous, incurved and prosogyrate, slightly anterior in position. Anterior dorsal margin higher and shorter than the sloping posterior shoulder; anterior lateral margin broadly arcuate, rounding smoothly into the upcurved base, the posterior lateral margin more oblique. Surface corroded, but obscure traces of growth wrinkles remaining. Characters of interior not known.

Holotype (paired valves, U. S. Nat. Mus. 498545) measures: Height, 14.0 mm; width, 14.0 mm; diameter, 11.0; mm. From lower part of Chickasawhay marl at station 14516, base of glauconitic bed in Chickasawhay River section, about 800 feet below the bridge on the Waynesboro-Laurel road, 2½ miles west of Waynesboro, Wayne County, Miss.

The reference of *Diplodonta waynensis* to the subgenus *Sphaerella* is uncertain. Superfically *Sphaerella* may be separated from *Diplodonta* by the thin, highly inflated shell and conspicuous umbones. The most significant differences, however, are to be found in the hinge, which in *D. waynensis* is inaccessible.

There is nothing in the upper Oligocene very close to this relatively small, high, and highly inflated species. *Diplodonta catopotium* Dall from the Tampa limestone is little more than half the size of the Chickasawhay form, and the beaks are much lower. The species which it most strongly resembles is *Diplodonta* (*Sphaerella*) *turgida* (Conrad), 1848, from the Red Bluff clay and the Mint Spring marl. *Diplodonta waynensis* is higher than the lower Oligocene species, not quite so strongly inflated, and with a less evenly rounded posterior lateral margin.

The type of *Diplodonta* (*Sphaerella*?) *waynensis* is unique.

Genus CARDIUM Linnaeus

Subgenus TRACHYCARDIUM Mörch

CARDIUM (TRACHYCARDIUM?) sp. A

Plate 25, figure 38

Specifically indeterminate internal and incomplete external molds of the old *Cardium*, s.l., are widespread in the upper Oligocene of western Alabama and southern Mississippi. Of the majority of the individuals only a few superficial characters remain, and they contribute little to the knowledge of the fauna. There was, obviously, a large *Cardium* representation in the lower Chickasawhay including probably a considerable number of species, some of them common. The figured squeeze of the left valve (U.S.N.M. 498548) probably referable to *Trachycardium* indicates a strongly inflated, subovate to suborbicular shell with an evenly rounded anterior lateral margin and a fairly well differentiated posterior area. There are 38 sharply rounded or obtusely V-shaped ribs, six of them on the posterior slope. A few traces remain of a rather strong concentric wrinkling near the distal extremities of the ribs, but other costal ornamentation, if it was ever developed, has been lost. The height of the shell was probably about 25 mm and the width approximately equal to the height. The mold is from station 14349, the glauconitic bed near the base of the Chickasawhay River section, one-fourth mile downstream from the bridge on the Waynes-

boro-Laurel Highway, 2½ miles west of Waynesboro, Miss.

Cardium precursor Dall from the lower Vicksburg is less strongly inflated, the ribs seem less crowded, and the intercostal channels more flattened. *Cardium eversum* Conrad, 1848, also from the Mint Spring marl member of the Marianna limestone, is relatively higher, more inflated, with more numerous, more rounded, and more closely spaced ribs. *Cardium* (*Trachycardium*) *hernandoense* Mansfield, 1937, from the Suwannee limestone is similar to *C. eversum* in relative dimensions and general outline, and the rib count runs up to 50. It is possible that the Chickasawhay species may be represented by those forms cited by Mansfield (1938, p. 104, figs. 7, 13) under the name of *Cardium* (*Trachycardium*) aff. *C. hernandoense* Mansfield from the Suwannee limestone of station 12723, the A. L. Parrish farm, 3½ miles southeast of Wausau, Washington County, Fla. Some of the Suwannee forms, however, seem closer to *Cardium precursor* Dall than anything indicated in the lower Chickasawhay.

Apparently similar Cardia were collected at station 13396, the hillside above the mouth of Limestone Creek, near the middle of sec. 25, T. 9 N., R. 7 W., and at station 14281, the "*Chione* limestone" at Taylor Mill Creek below the bridge on Highway 45, 1½ miles north of Waynesboro. The *Cardium* at station 14348, near the base of the Chickasawhay River section, one-fourth mile below the highway bridge on the Waynesboro-Laurel road, 2½ miles west of Waynesboro, does not have so many ribs, and there is a relatively higher *Cardium* with fewer ribs at station 14519, the old road on the east side of the new road south of Limestone Creek, about half-way up the hill, and at station 13386, the hill above the quarry at the mouth of Limestone Creek, Wayne County, Miss. Relatively higher Cardia with a higher rib count occur at a number of localities: Station 14205*a*, the overlying limestone in the gully about one-fourth mile north of Perdue Hill, Monroe County; station 14323, highest fossiliferous bed in ravine 200 yards south-southwest of Jones' old plantation house, about 1 mile northwest of Glendon Station; stations 7165 and 14322, uppermost fossiliferous bed on north side of Salt Creek on Jackson-Rockville road, sec. 34, T. 6 N., R. 2 E., 4½ miles south of Jackson, Clarke County, Ala.; station 14283, the "*Chione* limestone" at the top of the hill on the old road leading down to Limestone Creek, 3 miles north of Waynesboro; station 14282, blocks of "*Chione* limestone" along the road side which have probably fallen from station 14283; station 14281, the "*Chione* limestone," Taylor Mill Creek, below bridge on Highway 45, 1½ miles north of Waynesboro; station 13239, the NW ¼ sec. 17, T. 8 N., R. 5 W., Wayne County, Mississippi. A somewhat similar form retaining traces of costal nodes is associated with apparently simple ribbed forms at station 10334, one-fourth of a mile northeast of Perdue Hill, Monroe County, Ala. A less inflated, possibly somewhat oblique, multicostate species is indicated by molds from station 14293, at Weaver Chute on the east bank of the Conecuh River, sec. 18, T. 2 N., R. 13 E., Escambia County, Alabama.

Incerta sedis

There are a number of Cardia in the lower Chickasawhay, too imperfectly preserved to figure or to describe. A species between 45 and 50 mm high, with about 30 apparently smooth, flattened ribs is dimly recorded at station 14205*a*, the overlying limestone in a gully about one-fourth mile north of Perdue Hill, Monroe County, Alabama. There are a number of other ovate and ovate-trigonal *Cardium* molds at different horizons in the lower Chickasawhay, some with decorated ribs, others with no obvious costal ornamentations. Fragments of ribs with hooded imbrications similar to those of *Cardium* (*Trachycardium*) *glebosum* Conrad were collected at station 7211 on the east bank of Murder Creek, about 3 miles north of Castleberry, Conecuh County. A somewhat similar species occurs at station 7166, just south of Payne's Hammock on the Tombigbee River, Clarke County, Alabama. Another interesting but very imperfectly known *Cardium* occurs at station 7166, a species 30–35 mm high and 25–30 mm broad, with highly decorated, crowded ribs that must number well above 50. There is no other described spe-

cies from a comparable horizon in which the costals are so numerous and so highly adorned. Nothing like it occurs at any other locality in the upper Oligocene.

Subgenus CERASTODERMA Mörch
Section DINOCARDIUM Dall
CARDIUM sp. cf. C. (CERASTODERMA) PHLYCTAENA Dall
Plate 25, figures 34, 45

The synonomy of *Cardium* (*Cerastoderma*) *phlyctaena* Dall is as follows:

Cardium (*Cerastoderma*) *phlyctaena* DALL, *1900*, Wagner Free Inst. Sci., Trans., vol. 5, p. 1097, pl. 48, fig. 13.
Cardium (*Cerastoderma*) *phlyctaena* DALL, *1915*, U. S. Nat. Mus., Bull. 90, p. 144, pl. 25, fig. 10.
Cardium (*Thrachycardium*) *phlyctaena* Dall. MANSFIELD, *1937*, Florida Geol. Survey, Bull. 15, p. 253.

External molds closely comparable to *Cardium phlyctaena* Dall of the Tampa limestone occur in considerable abundance at station 14287, the waterfall on Patton Creek, one-fourth mile above Highway 45, 1½ miles east of Waynesboro, Miss. The characters retained, however, are not sufficient to make a determination sure. The rib counts in the Florida and Mississippi shells are similar and so, in a general way, are the ornamentations on the ribs, although the placement of the spines on the posterior ribs seems to be at the ventral margin in the Mississippi form and at the dorsal margin in the type of *C. phlyctaena*. The Patton Creek molds also seem to indicate a rather more inflated species than that described by Dall, and the angle between the anterior dorsal and lateral margins seems less obtuse than *C. phylctaena*.

The figured squeeze of the external mold of a left valve is U. S. Nat. Mus. 498549.

There is no record of the species at any other locality.

Genus TRIGONIOCARDIA Dall
TRIGONIOCARDIA sp., cf. TRIGONIOCARDIA GADSDENENSE (Mansfield)

A single incomplete specimen of *Trigoniocardia* was collected in the lower part of the Chickasawhay marl at station 7166, bed no. 3 of the section on the east bank of the Tombigbee River just south of Payne's Hammock, Clarke County, Alabama. This left valve (U.S.N.M. 498546) cannot in its present poorly preserved state be separated from molds and shell fragments from the Suwannee limestone in northern Florida segregated by Mansfield, 1937, under the name *Cardium* (*Trigoniocardia*) aff. *C. gadsdenense* Mansfield. They were considered distinct from *C. gadsdenense* s.s. because of the more rounded keel and more widely spaced ribs.

Genus NEMOCARDIUM Meek
NEMOCARDIUM DIVERSUM WAYNENSE Mansfield, n. subsp.
Plate 25, figures 27, 28

Holotype, a right valve, crushed at the umbone so that it appears relatively lower and wider than it would be in a perfect state. Shell very thin and fragile, evenly inflated along both the vertical and the horizontal axes. Anterior lateral margin smoothly rounding into the arcuate base; ventral margin not depressed in front of the posterior area. Posterior lateral margin truncate, the posterior area strikingly defined by the sculpture, probably feebly concave. Entire medial portion of shell finely lineated radially, the radials overrun and cancellated by an even finer concentric imbrication, faintly visible beneath the surface veneer. Radials not quite so fine toward the anterior dorsal margin and absent upon a very narrow area adjacent to the margin. Posterior area threaded with about 29 lirae minutely beaded by the incrementals, the three or four posterior lirae veiled by the surface polish, and adjacent to the dorsal margin a smooth band even more narrow than that which parallels the anterior dorsal margin. Characters of hinge and interior not known but probably similar to those of *Nemocardium diversum* (Conrad).

Holotype (U. S. Nat. Mus. 498547, a right valve) measures: Height, 23 mm; width, 25 mm; convexity, 10 mm. From station 14204, lower blue marl east of bridge over Taylor Mill Creek, on Highway 45, 1½ miles north of Waynesboro, Wayne County, Miss.

The subspecies *waynense* differs from *Nemocardium diversum* s.s., described by Conrad from the Byram marl at Vicksburg, in the finer radial sculpture on the posterior

area and the absence of the constriction in front of the posterior keel, which tends to sinuate the base line. The radial threads on the posterior area of *N. diversum* range in number from 20 to 25; those on the subspecies *waynense* average about 29; and the concentric laminae seem less faint and more closely spaced in the subspecies. The molds seem much higher relatively than the holotype, probably because of the crushing of the holotype in the umbonal area. Molds of *Nemocardium* from the Suwannee limestone of Hernando County, Florida may be related.

Occurrence.—Lower part of Chickasawhay marl. ALABAMA: Station 6735?, east end of wagon bridge over Murder Creek east of Castleberry, Conecuh County (internal and incomplete external molds). Station 14205*a*, limestone ledge in gully about one-fourth mile north of Perdue Hill, Monroe County; station 14291?, railroad and road cut about 1.3 miles north of Millry, Washington County. MISSISSIPPI: Station 14284?, just north of Limestone Creek on new highway, 3 miles north of Waynesboro (one external mold); station 13396, hillside above mouth of Limestone Creek near middle of sec. 25, T. 9 N., R. 7 W.; station 14204, lower bed of blue marl just east of bridge over Taylor Mill Creek, on Highway 45, 1½ miles north of Waynesboro; stations 14347 and 14281, "*Chione* limestone" overlying blue marl at station 14204; station 13239, NW ¼ sec. 17, T. 8 N., R. 5 W., Bucatunna Creek locality, Wayne County.

Genus MACROCALLISTA Meek
Subgenus CHIONELLA Cossmann
MACROCALLISTA (CHIONELLA?) sp. cf. M. (CHIONELLA) SOBRINA (Conrad)
Plate 25, figure 22

A slightly damaged right valve from the lower Chickasawhay at station 14205 (the soft marl beneath the limestone ledge, one-fourth mile north of Perdue Hill, Monroe County, Ala.) may be referable to *Macrocallista* (*Chionella?*) *sobrina* (Conrad), abundant in the Byram marl at Vicksburg, Miss. The shell of the Perdue Hill species seems a little lighter than that of *M. sobrina*, and the umbone more narrow and pointed. *Macrocallista tia* Kellum from the Trent marl of North Carolina is heavier and more compact than both *M. sobrina* and the Perdue Hill specimen, with a shorter posterior margin and broader, more rounded umbones.

The figured right valve (U.S.N.M. 498550) is the only one of its kind that has been recognized. The height is 23.5 mm; the width, 27.0 mm.

The subgenotype of *Chionella* is *Cytherea ovalina* Lamarck, from the Calcaire grossier of the Paris Basin. The dimensions and outline of *C. ovalina* are similar to those of *M. sobrina*, but the shell is much thinner and the hinge more delicate.

MACROCALLISTA (CHIONELLA?) PERDUENSIS Mansfield, n. sp.
Plate 25, figures 19, 30, 31

Shell small for the genus and rather thin, polished and porcellaneous in the fresh specimen, transversely elongate-ovate in outline. Beaks rather small and low, turned inward and forward, anterior in position. Lunule rather long, not very wide, cordate, defined by an incised linear groove. Anterior lateral margin arching smoothly outward in front of lunule. Posterior lateral margin produced and narrowly rounded at its extremity. Base line feebly arcuate medially, upturned anteriorly. Outer surface wrinkled and striated incrementally but with no definite sculpture pattern. Characters of interior imperfectly known but apparently similar to those of *M.* (*Chionella?*) *sobrina* (Conrad).

Syntypes measure: Right valve (U. S. Nat. Mus. 498551): Height, 17.5 mm; width, 27.5 mm. Left valve (U. S. Nat. Mus. 498552): Height, 18.0 mm; width, 27 ± mm. Topotype (U. S. Nat. Mus. 498553, a left valve): Height, 18.5 mm; width, 25.0 mm. From the lower part of the Chickasawhay marl at station 14205, soft blue marl beneath limestone ledge, one-fourth mile north of Perdue Hill, Monroe County, Ala.

Macrocallista (*Chionella?*) *perduensis* suggests a rather thin, compressed, and posteriorly produced *Macrocallista* (*Chionella?*) *sobrina* (Conrad). It is much smaller than the Miocene species *M. acuminata* Dall from the Chipola formation of Florida and smaller than the subquadrate *M. minuscula*

Kellum from the Trent marl at Silverdale, North Carolina. The transversely elongate Tampa species, *M. floridana* (Conrad), however, is a smaller and lower shell than *M. perduensis*. *Macrocallista* (*Chionella?*) *perduensis* is fairly common at the type locality but has not been recognized elsewhere unless an internal mold of a right valve from station 14349 (the glauconitic bed near the base of the Chickasawhay River section, one-fourth mile downstream from the highway bridge on the Waynesboro-Laurel road, 2½ miles west of Waynesboro) should be referred to this species. In outline the mold seems about midway between *M. sobrina* and *M. perduensis*.

Genus CHIONE Megerle von Mühlfeld
Subgenus CHIONE s. s.

CHIONE (CHIONE) BAINBRIDGENSIS Dall
Plate 25, figure 46

Chione bainbridgensis DALL, *1916*, U. S. Nat. Mus., Proc., vol. 51, p. 499, pl. 84, fig. 5 (holotype), fig. 6 (paratype).

Chione aff. *C. bainbridgensis* Dall. MANSFIELD, *1937*, Florida Geol. Survey, Bull. 15, p. 269 (in part).

Chione cf. *C. spenceri* MANSFIELD, *1938*, Washington Acad. Sci., Jour., vol. 28, no. 3, p. 105, fig. 8. Not *Chione spenceri* Cooke, 1919.

The holotype of *Chione bainbridgensis* Dall is a fragment of the posterior part of the shell, and the paratype is a squeeze of an external mold. The paratype shows the character of the original shell much better than the holotype. My first interpretation of the relationship of the specimens from 3½ miles southeast of Wausau, all of them external molds, was that they were more closely related to *C. spenceri* Cooke from Antigua, Leeward Islands, than to *C. bainbridgensis* Dall. *Chione bainbridgensis* and *C. spenceri* are closely related to each other, but the Antiguan shell is a little lower and more elongate, the beaks are more flattened on their summits, and there is a feeble depression in front of the posterior dorsal border which I have not observed on the specimens from Bainbridge.

Later collections from Bainbridge made by August F. Foerste are better preserved than Dall's type material. The figured mold of the right valve (U.S.N.M. 498554) is from station 14205*a*, one-fourth mile north of Perdue Hill, Clarke County, Alabama.

The species is commonly represented in the Flint River formation at several places near Bainbridge, Ga., in the Suwannee limestone at station 12723, 3½ miles southeast of Wausau, Washington County, and several places cited by Mansfield (1937) under *Chione* aff. *C. bainbridgensis* Dall. Juveniles and incomplete molds from the Tampa limestone are only tentatively referred to *C. bainbridgensis*. The specimens from the Tampa limestone at station 12292, Cherokee Sink, Wakulla County, Florida, may be conspecific with those from the upper Chickasawhay at station 14287, Patton Creek, 1½ miles east of Waynesboro, Miss.

Chione bainbridgensis is widely distributed in the lower part of the Chickasawhay marl in western Alabama and eastern Mississippi.

Occurrence.—Lower part of Chickasawhay marl. ALABAMA: Stations 6758 and 14292, south bank of Yellow River, site of Watson [Watkins] and Henderson bridge, sec. 13, or 14, T. 1 N., R. 15 E., Covington County; Stations 2398 and 14025*a*, limestone in gully about one-fourth mile north of Perdue Hill; station 10334, one-fourth mile northeast of Perdue Hill, Monroe County; station 14323, highest fossiliferous bed in ravine 200 yards south-southwest of Jones' old plantation house, about 1 mile northwest of Glendon Station; stations 7165 and 14322, uppermost fossiliferous bed 200 yards north of Salt Creek, on Jackson-Rockville road, 4½ miles south of Jackson; station 7166, east side of Tombigbee River, just south of Payne's Hammock, Clarke County. MISSISSIPPI: Station 14283, "*Chione* limestone" from the top of hill on old road leading down to Limestone Creek, 3 miles north of Waynesboro; station 14282, blocks of "*Chione* limestone" along roadside, probably fallen from station 14283; station 14519, old road on east side of new road, south of Limestone Creek, about halfway up the hill; station 14204, lower bed of blue marl, just east of bridge on Highway 45, 1½ miles north of Waynesboro; station 14281, "*Chione* limestone" overlying marl at station 14204; station 14360, *Kuphus* bed near base of Chickasawhay River section, one-fourth mile downstream from bridge on Waynesboro-Laurel road, 2½

miles west of Waynesboro; station 14348, sandstone near base of Chickasawhay River section; stations 14349, 14361, and 14362, glauconitic sands in lower part of Chickasawhay River section; station 14363?, glauconitic clays and sands in middle part of Chickasawhay River section; station 13239?, NW ¼ sec. 17, T. 8 N., R. 5 W., Bucatunna Creek, Wayne County.

Upper part of Chickasawhay marl: MISSISSIPPI: Station 14287?, waterfall on Patton Creek, one-fourth mile above Highway 45, 1½ miles east of Waynesboro, Wayne County, (two incomplete molds).

Subgenus LIROPHORA Conrad

CHIONE (LIROPHORA) PERDUENSIS Mansfield, n. sp.

Plate 25, figures 41, 42, 44

Shell growing large for the genus, high, transversely ovate-trigonal in outline, rather strongly inflated. Umbones full, acutely tapering, bent forward and inward. Anterior lateral margin sweeping outward and downward in a strong, smooth arc and merging into the upcurved base. Posterior dorsal margin obliquely produced from the umbones to the short, truncate lateral margin. Lunule long, cordate in the double valves, defined by a deeply incised groove, wrinkled by the incrementals. Escutcheon produced the length of the dorsal margin, lanceolate, obliquely chased with fine, low-lying growth laminae. Umbonal area concentrically laminated, the anterior and medial parts of the shell heavily ribbed, the lamellae becoming increasingly wide and prominent; the free edges on the adult shell curved backward toward the umbones, pinching out on the dorsal area into narrow flanges, which disappear abruptly at the margin of the escutcheon. Thickened edges and concave dorsal faces of lamellae smooth, the lower two-thirds of the ventral margin and the basal edge of the valve closely fluted with strong, upright, rounded riblets. Interlamellar spaces smooth except for faint radial and growth striae. Inner lateral and basal margins from the beak to the distal extremity of the escutcheon finely crenate. Interior of right valve not known. Ligament groove deep, produced about half the length of the posterior dorsal margins. Anterior cardinal short, rather slender and oblique, the medial cardinal short, deltoid, broken in the holotype; the posterior cardinal laminar and produced, fused with the ventral base of attachment of the ligament. Muscle scars distinct. Pallial line rather distant from the margin, the sinus short and acutely angulated.

Holotype (an almost perfect left valve, U. S. Nat. Mus. 498555) measures: Height, 20.0 mm; width, 22.5 mm; convexity of single valve, 8.0 mm. Paratype (the external mold of a left valve, U. S. Nat. Mus. 498556) measures: Height, 29.0 mm; width, 35.0 mm. Holotype from station 14205, blue marl underlying limestone ledge in gully one-fourth mile north of Perdue Hill, Monroe County, Ala. Paratype from station 14281, "*Chione* limestone," Taylor Mill Creek, 1½ miles north of Waynesboro, Wayne County, Miss.

Chione perduensis recalls *Chione* (*Lirophora*) *victoria* Dall of the lower Vicksburg, from which the later Gulf Oligocene *Lirophora* presumably stemmed. The holotype of *C. victoria* is much more closely ribbed than the Perdue Hill species, and the fluting on the base of the outer surface of the ribs much stronger and more consistently developed. *Chione ballista* Dall of the Tampa limestone fauna more closely resembles in general aspect the lower Oligocene species from western Mississippi than it does the upper Oligocene form from western Alabama and eastern Mississippi. Molds from station 14322 indicate a species closely related to *C. perduensis* but relatively higher and with more widely spaced concentric lamellae.

Occurrence.—Lower part of the Chickasawhay marl. ALABAMA: Station 14205, soft marl under limestone ledge in gully about one-fourth mile north of Perdue Hill, Monroe County; station 14205*a*, limestone in gully about one-fourth mile north of Perdue Hill; station 10334, one-fourth mile northeast of Perdue Hill, Monroe County; station 7163, gully north of Walker Springs-Jackson road, 1 mile north of Glendon. MISSISSIPPI: Station 14283, "*Chione* limestone," top of hill on old road leading down to Limestone Creek, 3 miles north of Waynesboro; station 14282, blocks of "*Chione* limestone" along roadside probably fallen from station 14283; station

13396, hillside above mouth of Limestone Creek, near middle of sec. 25, T. 9 N., R. 7 W.; station 14281, "*Chione* limestone" below bridge at Taylor Mill Creek, on Highway 45, 1½ miles north of Waynesboro.

Subgenus CHAMALEA Mörch

CHIONE (CHAMALEA) CATUNNA Mansfield, n. sp.

Plate 25, figures 47, 48

Shell rather large, transversely ovate, inequilateral, moderately inflated. Posterior dorsal margin obliquely produced, the lateral and ventral margins apparently rounded on some individuals more strongly than on others. Characters of the lunule and escutcheon not known from the molds. Sculpture fairly sharp and regular in the umbonal region, the laminae becoming less regular and more crowded on the ventral half of the shell. Interlaminar spaces concentrically striated, with occasional fortuitous radial markings across the umbones. Inner margins crenate. Other characters of interior not known.

External molds of syntypes (a right and a left valve of two different individuals, from station 14508*a*, bed no. 4, on Bucatunna Creek, about 200 yards below Steep Hill Branch, SE¼ sec. 18, T. 8 N., R. 5 W., Wayne County, Mississippi, U. S. Nat. Mus. 498557) measure: Right valve: Height, 21 mm; width, 26 mm. Left valve: Height, 23 mm; width, 27 mm.

The absence of a defined radial sculpture and the relatively feeble and irregular concentric sculpture will readily isolate *Chione catunna* from the other described *Chione* in the lower Chickasawhay. *Chione* (*Chamalea*) *rhodia* from the Tampa limestone is similar in general form, and like *C. catunna* is sharply and distantly corded in the umbonal region. The Tampa limestone species is more compressed than that from Bucatunna; it is more flattened toward the umbones, and the tips of the umbones are more strongly prosogyrate than in *C. catunna*.

Occurrence.—Lower part of Chickasawhay marl. MISSISSIPPI: Station 14508, Bucatunna Creek, about 200 yards below Steep Hill Branch, SE ¼ sec. 18, T. 8 N., R. 5 W., bed no. 3; station 14508*a*, bed no. 4 of the section at station 14508; station 13241, sec. 18, T. 8 N., R. 5 W., Wayne County.

CHIONE (LIROPHORA) sp.

Plate 25, figure 43

Two crushed left valves of *Chione* (*Lirophora*), closely related to *Chione* (*Lirophora*) *perduensis*, were recovered from the lower blue marl at station 14204, east of the bridge over Taylor Mill Creek on Highway 45, 1½ miles north of Waynesboro, Miss. One of these (U.S.N.M. 498558) has been figured. The sculpture is similar to that of *C. perduensis*, and the relative dimensions are distorted by crushing, so that the shell seems lower in the figure than it really was. There were, however, certain original differences in the outline of the anterior and ventral margins of the two forms that may be of taxonomic significance. At Perdue Hill in Clarke County, Ala., it does not seem possible to separate the *Chione* (*Lirophora*) in the limestone from that in the marl beneath, although the earlier form is the smaller. The valves from the marl on Taylor Mill Creek are about the size of the holotype from the lower bed at Perdue Hill, and the "*Chione* limestone" overlying the marl on Taylor Mill Creek has furnished the paratype of *Chione perduensis*. Examples of *C. perduensis* might, therefore, be reasonably expected from the marl underlying the limestone at Taylor Mill Creek as well as at Perdue Hill.

Genus CORBULA (BRUGUIÈRE) Lamarck

Subgenus CORBULA s. s.

CORBULA (CORBULA) LAQUEATA Casey?

Plate 26, figures 8, 10

Corbula laqueata CASEY, *1903*, Acad. Nat. Sci. Philadelphia, Proc., p. 261.

The name was used by Conrad in manuscript and in check lists but had no standing until Casey's description was published.

Two small right valves (U.S.N.M. 498560) suggesting *Corbula laqueata* in miniature were collected at station 14204, the lower blue marl east of the bridge on Taylor Mill Creek, on Highway 45, 1½ miles north of Waynesboro, Miss. The larger valve is only 3.2 mm high by 3.8 mm wide, and the smaller is 3.0 mm high by 3.2 mm wide, a little more than half the size of the average *C. laqueata*. The sculpture seems to run farther up on the beaks on the eastern

Mississippi forms than it does in the Vicksburg species, and though the identity of the Wayne County and Vicksburg specimens is by no means established, the relationship must certainly be close.

Similar right valves occur at the following localities in the lower part of the Chickasawhay marl: ALABAMA: Station 7165, bed no. 5 of the section 200 yards north of Salt Creek on the Jackson-Rockville road, 4½ miles south of Jackson, Clarke County. MISSISSIPPI: Station 13396, hillside above mouth of Limestone Creek, near middle of sec. 25, T. 9 N., R. 7 W.; stations 14349 and 14362, glauconitic bed near base of Chickasawhay River section, one-fourth mile downstream from bridge on Waynesboro-Laurel road, 2½ miles west of Waynesboro, Wayne County.

Subgenus CARYOCORBULA Gardner
CORBULA (CARYOCORBULA) TAYLORENSIS Mansfield, n. sp.
Plate 25, figures 29, 32, 37

Shell rather small, moderately heavy; inequilateral, not conspicuously inequivalve, but the right valve slightly larger and less compressed than the left. Outline transversely ovate, the base line of the right valve more flexuous than that of the left, and the depression in front of the acute posterior keel more marked. Posterior area feebly concave in both valves, the posterior dorsal margin more elevated in the right valve. Umbones subcentral, flattened, the beaks turned inward and forward. Anterior end broadly rounded, the posterior narrow and obliquely truncate. Both the right and the left valves concentrically wrinkled, the rugae absent upon the umbonal third, finer and more crowded in the left valve, dying out abruptly on the rostrum in both valves. Posterior area sculptured only with sharp growth laminae. Ligament internal, mounted on a cuneate condrophore projecting from the dorsal margin of the right valve and received in the umbonal socket of the left. Right cardinal heavy, trigonal, flattened on the ventral surface, upcurved at the tip, received in a correspondingly wide socket beneath the left umbone. Mantle cavity excavated. Adductor scars distinct, especially the posterior, which is thickened and semielliptical in outline. Pallial line obscure, entire, nearer to the base posteriorly than anteriorly. Gutter near the margin of the right valve indicating the line of closure of the left and running very close to the edge except on the posterior ventral part.

The three syntypes (U. S. Nat. Mus. 498559) measure: First right valve: Height, 5.5. mm; width, 8.0 mm; left valve: Height, 5.0 mm; width, 7.3 mm; second right valve: Height 5.7 mm; width 8.0 mm. From station 14204, blue marl east of bridge over Taylor Mill Creek, on Highway 45, 1½ miles north of Waynesboro, Wayne County, Miss.

Corbula taylorensis is closely related to *Corbula engonata* Conrad described from Vicksburg. However, it is a higher shell than *C. engonata*, and the concentric sculpture is finer and more regular.

Occurrence.—Lower part of Chickasawhay marl: MISSISSIPPI: Stations 14204 and 14346, lower bed of blue marl at Taylor Mill Creek, on Highway 45, 1½ miles north of Waynesboro; station 14349?, glauconitic bed near base of Chickasawhay River section, one-fourth mile downstream from bridge on Waynesboro-Laurel road, 2½ miles west of Waynesboro (internal mold only); station 14363?, glauconitic clay in middle part of the Chickasawhay River section, one-fourth mile downstream from bridge on Waynesboro-Laurel road, 2½ miles west of Waynesboro, Wayne County.

Genus PANOPE Menard de la Groye
PANOPE TAYLORENSIS Mansfield, n. sp.
Plate 25, figure 49

Panope cf. *P. parawhitfieldi* Gardner. MANSFIELD, *1938*, Washington Acad. Sci., Jour., vol. 28, no. 3, p. 107, fig. 19.

The internal mold cited in 1938 was a juvenile from the Suwannee limestone at station 12723, the A. L. Parrish farm, 3½ miles southeast of Wausau in Washington County, Fla. The present collection from the lower Chickasawhay includes an almost complete though somewhat crushed adult left valve from station 14204, the lower blue marl east of the bridge, on Taylor Mill Creek, on Highway 45, 1½ miles north of Waynesboro. The outline is relatively higher and shorter than that of the Oak Grove species. In *Panope taylorensis* the height slightly exceeds half the width; in *P. para-*

whitfieldi the width is more than double the height. The best diagnostic for separation is in the structure of the shell itself, which in *P. parawhitfieldi* is strongly pustulose; in *P. taylorensis* the pustules are absent or only faintly indicated. *Panope goldfusii* Wagner from the Chesapeake of Maryland and Virginia is more produced and more constricted posteriorly. *Panope oblongata* Conrad, 1848, from the Vicksburg, and *P. brooksvillensis* Mansfield, from the Suwannee limestone of Hernando County, Florida, are both lower and more slender shells, more inequilateral, and more produced and attenuated posteriorly. The Suwannee species is known only from molds, but the shells of *P. oblongata* are not rare and show traces of the pustulose surface sculpture so well developed in *Panope parawhitfieldi*.

Holotype (a left valve, U. S. Nat. Mus. 498561)from the lower part of the Chickasawhay marl at station 14204, lower blue marl east of the bridge over Taylor Mill Creel, on Highway 45, 1½ miles north of Waynesboro, Wayne County, Miss., measures: Height, 53 mm (possibly somewhat exaggerated by crushing); width, 100 mm.

An incomplete mold of the posterior part of the shell from station 14282 may be referable to *Panope taylorensis*. The locality is about 3 miles north of Waynesboro, on a side road near Limestone Creek, where blocks of "*Chione* limestone" had apparently fallen from the hill above.

Genus KUPHUS Guettard

The separation of borings similar in a general way to those of the Recent *Teredo* is based on the matrix in which the tubes are found. The borings in wood are referred tentatively to *Teredo*, those in the matrix of sedimentary origin to *Kuphus*.

KUPHUS INCRASSATUS Gabb

Plate 27, figure 35

Kuphus incrassatus GABB, *1873*, Am. Philos. Soc., Trans., vol. 15, p. 246.
Kuphus incrassatus GABB, *1881*, Acad. Nat. Sci. Philadelphia, Jour., n. ser., vol. 8, p. 342, pl. 44, figs. 12a–e.
Teredo circula ALDRICH, *1886*, Alabama Geol. Survey, Bull. 1, pt. 1, p. 36.
Teredo incrassata MAURY, *1917*, Bull. Am. Paleontology, vol. 5, p. 399, pl. 39, fig. 24.
Teredo (*Kuphus*) *incrassata* PILSBRY, *1922*, Acad. Nat. Sci. Philadelphia, Proc., vol. 73, pt. 2, p. 428.
Kuphus (*Kuphus*) aff. *polythalmia* (Linné). COX, *1927*, Rept. Paleontology Zanzibar Protectorate, p. 62 (in part).
Teredo? incrassata MANSFIELD, *1937*, Florida Geol. Survey, Bull. 15, p. 282, pl. 21, fig. 4.
Teredo? incrassata MANSFIELD, *1938*, Washington Acad. Sci., Jour., p. 107, fig. 15.

The type locality of *Kuphus incrassatus* is "the brown earthy shale east of Guayabin" (Santo Domingo). The species occurs at a number of places in the Dominican Republic, particularly in the Cercado formation. The type locality of *Teredo circula* Aldrich is at Choctaw Bluff on the Alabama River in Clarke County, Alabama. If it is later proved, as it well may be, that more than one species is involved in these large tubes abundantly distributed in the middle Tertiary in the mid-American area, Aldrich's name will be available for the representatives in the upper Oligocene in the middle Gulf.

The assumption, however, of a close relationship between *K. incrassatus* Gabb of the upper Oligocene and lower Miocene mid-American faunas and *K. polythalmia* Linnaeus, living in the Indian Ocean does not seem justified.

Occurrence.—Lower part of Chickasawhay marl: ALABAMA: Station 11088, Choctaw Bluff, Alabama River; stations 7165 and 14325, bed no. 5 of section 200 yards north of Salt Creek, 4½ miles south of Jackson; station 301, Gainestown; station 3640, Payne's Hammock, 10 miles south of Jackson, Clarke County. MISSISSIPPI: Station 10053, road from Shubuta to Waynesboro, 4 miles north of Waynesboro; station 14285, bed above "*Chione* limestone," near Limestone Creek Church, 4 miles north of Waynesboro; station 13386, hill above quarry at mouth of Limestone Creek, 3 miles northwest of Waynesboro; station 13385, one-eighth mile north of Limestone Church, 1½ miles southeast of Boyce; station 14282, blocks of "*Chione* limestone" along roadside near Limestone Creek, probably fallen from top of hill, 3 miles north of Waynesboro; station 14281, "*Chione* limestone," Taylor Mill Creek, 1½ miles north of Waynesboro; stations 14348 and 14515, *Kuphus* bed near base of Chickasawhay River section about 800 feet below the bridge on the Waynes-

boro-Laurel road, 2½ miles west of Waynesboro, Wayne County.

Similar tubes are abundant throughout the Suwannee limestone of Florida, in the Oligocene of eastern Mexico, and of Anguilla and Puerto Rico. Gabb's types were probably from the Cercado formation, lower Miocene of the Dominican Republic. The figured tube is U.S.N.M. 496240 from the Suwannee limestone at station 12298, in Jefferson County, Fla.

Genus DENTALIUM Linnaeus
DENTALIUM sp.

Fragments of *Dentalium* preserved as external molds have much in common with *Dentalium ladinum* Dall (1916, p. 522, pl. 85, fig. 6) from the Suwannee limestone at Rock Island, one-half mile above the wagon bridge at White Springs, Florida. From the imperfect naterial the Chickasawhay tubes seem less arcuate than those of *D. ladinum* and the intercalaries are apparently introduced at a later growth stage. The shells of *Dentalium* sp. are not so large and coarse as those of *D. mississippiense*, but the fragmentary material does little more than establish the genus in the lower Chickasawhay.

Dentalium sp. was collected in the lower part of the Chickasawhay marl at station 6758, on the south bank of the Yellow River at Watson [Watkins] and Henderson wagon bridge in Covington County, Ala., 4 miles north of the Florida line; and at station 6749, the west bank of the Conecuh River, at McGowan's Bridge, Escambia County, Ala., about 1 mile below the mouth of Sepulga River.

Genus CADULUS Philippi
CADULUS WAYNENSIS Mansfield, n. sp.
Plate 27, figure 33

Shell small, polished, moderately slender and feebly arcuate. Dorsal margin nearly straight except near the posterior extremity. Ventral margin arcuate, the maximum diameter falling within the anterior fourth. Margin of apical opening broken slightly, so that the presence or absence of slits cannot be determined. Anterior orifice nearly circular.

Holotype (U. S. Nat. Mus. 498491) measures: Length, 4.5 mm; maximum diameter, 1.2 mm. From the lower part of the Chickasawhay marl at station 14346, Taylor Mill Creek, the lower bed of blue marl just below the bridge on Highway 45, 1½ miles north of Waynesboro, Wayne County, Miss. A further collection, station 14204, was later made from this same locality.

Cadulus vicksburgensis Meyer from the Byram marl of Mississippi is a more slender shell, with no conspicuous zone of inflation.

Only the holotype of *Cadulus waynensis* Mansfield and three topotypes from stations 14346 and 14204 are known.

Genus ACTEON Montfort
ACTEON sp.
Plate 27, figure 42

A single incomplete specimen consisting of the greater part of the body whorl was collected from the lower part of the Chickasawhay marl at station 14204, the lower bed at the bridge over Taylor Mill Creek, 1½ miles north of Waynesboro, Wayne County, Miss. The entire body whorl is spirally striated by grooves, which are rather widely separated, except on the basal area, where the interspaces are much narrower. The characteristic *Acteon* sculpture of fine axial grating is developed in the grooves. The specimen is too incomplete to name.

The figured specimen (U.S.N.M. 498453) is 8 mm high.

Casts from Perdue Hill (station 10334), Monroe County, Ala., seem closely related to *Acteon* sp., but the specific identity is uncertain.

Genus CYLICHNA Lovén
CYLICHNA sp.
Plate 27, figure 24

One small and possibly immature specimen of the genus *Cylichna* (U.S.N.M. 498454) was collected from the lower Chickasawhay at station 14204, the lower bed at the bridge over Taylor Mill Creek, 1½ miles north of Waynesboro, Wayne County, Miss. The specimen may represent a new species, but the material hardly justifies the naming of it.

The shell is subcylindrical and smooth, except for very faint, revolving lines on the anterior third of the body. The spire is sunken and perforate, and the outer lip longer than the axis of the body whorl. The aperture is narrow and dilated anteriorly; the

pillar reinforced and reversed in front, leaving behind it a narrow, crescentic, umbilical chink. The length of the shell is 2.9 mm; the maximum diameter, 1.3 mm. Nothing closely comparable to it has been observed in the Oligocene or Tampa faunas.

Genus TEREBRA Bruguière
Subgenus STRIOTEREBRUM Sacco
TEREBRA (STRIOTEREBRUM) WAYNESBOROENSIS
Mansfield, n. sp.
Plate 27, figure 23

Shell small, very slender, moderately solid, including 2½ nuclear and 13 postnuclear whorls. Initial half-turn largely immersed, the two succeeding volutions slender and smooth. Postnuclear whorls marked by a prominent subsutural band, comprising about one-third of the whorl and defined anteriorly by a deeply incised groove. Axials about 16 to the whorl, moderately strong, feebly arcuate, triangular in outline, medially and anteriorly dissected by the subsutural groove but persisting from the anterior to the posterior suture. Spiral sculpture of obscure striae, apparent only under high magnification. Body whorl constricted basally into a moderately long and slender pillar. Anterior fasciole twisted slightly and defined posteriorly by a thin and sharply elevated keel. Pillar without observed plications.

Holotype (U. S. Nat. Mus. 498455) measures: Height, 23.5 mm; diameter, 4.2 mm. From the lower part of the Chickasawhay marl at station 14204, lowest bed at bridge over Taylor Mill Creek, 1½ miles north of Waynesboro, Wayne County, Miss.

Terebra waynesboroensis is closely allied to *Terebra tantula* Conrad from the Byram marl but differs from the Vicksburg species in the obscurity and irregularity of the spiral sculpture. The size and slender outline are similar in the two species.

Terebra ballista Mansfield from the Tampa limestone has a greater apical angle than that of *T. waynesboroensis*, and the incised line delimiting the subsutural band of *T. ballista* is much more shallow.

The species is known only from the type locality.

TEREBRA (STRIOTEREBRUM) TANTULA
Conrad?
Plate 27, figure 22

A fragment of *Terebra* (*Strioterebrum*) from station 14204, the lower bed near the bridge at Taylor Mill Creek, 1½ miles north of Waynesboro, Wayne County, Miss., may be referable to *T. tantula* Conrad, described from the Byram marl at Vicksburg, Miss. The spiral sculpture of the fragment in question is, however, a little coarser than that of typical *T. tantula*. The proper relationship of the specimen cannot be established until further material is obtained.

The figured specimen (U. S. Nat. Mus. 498456) is from the lower part of the Chickasawhay marl.

Genus CONUS Linnaeus
CONUS sp. aff. C. IMITATOR
Brown and Pilsbry

An imperfect external mold of a small specimen (U.S.N.M. 498457) belonging to the genus *Conus* has been collected from the lower Chickasawhay in the highest fossiliferous bed in a ravine about one mile northwest of Glendon Station, Clarke County, Ala. (station 14323). It closely resembles a specimen determined as *Conus* sp. aff., *C. imitator* Brown and Pilsbry collected from the Suwannee limestone in the upper bed on the A. L. Parrish farm about 3½ miles southeast of Wausau, Washington County, Fla.

Genus PLEUROFUSIA DeGregorio
PLEUROFUSIA sp. cf. P. VICKSBURGENSIS
Casey
Plate 27, figure 6

External molds revealing the greater part of a shell comparable to that of *Pleurofusia vicksburgensis* Casey from the Byram marl were collected from the lower part of the Chickasawhay marl at station 14349, the greensand marl of the Chickasawhay River section, one-fourth mile downstream from the bridge on the Waynesboro-Laurel road, 2½ miles west of Waynesboro, Wayne County, Miss. The figured, imperfect external mold, possible representing the same species, was found at station 6753, Weaver Chute, on the east side of the Conecuh River, Escambia County, Ala. The lecto-

type of *P. vicksburgensis* Casey (U.S.N.M. 481670) is figured by Harris in Palaeontographica Americana, vol. 2, no. 7, pl. 10, fig. 3. It indicates a species more strongly rippled axially than that from the Chickasawhay and has a spiral sculpture pattern which differs slightly in detail from that represented by the molds. The incomplete, figured mold (U.S.N.M. 498458) measures about 20 mm in height.

PLEUROFUSIA species
Plate 27, figure 5

An internal mold of the upper part of the spire (U.S.N.M. 498459) has been collected at station 14349, the greensand marl, of the Chickasawhay River section, one-fourth mile downstream from the bridge on the Waynesboro-Laurel road, 2½ miles west of Waynesboro, Wayne County, Miss. The mold indicates a shell comparable to but not conspecific with the shell from the same locality identified as *Pleurofusia* sp. cf. *P. vicksburgensis* Casey. *Pleurofusia* sp. is related also to an undescribed species from the Mint Spring marl member of the Marianna limestone, but, on account of the imperfect preservation of the Chickasawhay species, its analogy to that from the Mint Spring marl cannot be established.

Genus PLEUROLIRIA DeGregorio
PLEUROLIRIA? WAYNENSIS
Mansfield, n. sp.
Plate 27, figure 21

Shell of moderate dimensions, slender. Nuclear and early postnuclear whorls lost. Seven whorls, including the body, remaining. Axial sculpture restricted to incrementals. Spiral sculpture of revolving lines of varying degrees of prominence. Whorls carinated a little behind the middle by a strong flattened spiral; a second spiral of similar character but not so wide and less elevated revolving a little in front of the posterior suture; two other spirals, comparable to that in front of the suture, girdling the base of the body. Fine, sharp lirae not uniform in strength developed over the entire conch. Incrementals strong, sharp and regular, especially on the body; protractive in front of the carina, retractive behind it. Body whorl slender and gently constricted; anterior canal lost.

Incomplete holotype (U. S. Nat. Mus. 498460) measures: Height, 12 mm; diameter, 4.5 mm. From the lower part of the Chickasawhay marl at station 14204, lower bed at bridge over Taylor Mill Creek, 1½ miles north of Waynesboro, Wayne County, Miss.

Pleuroliria? waynensis, n. sp., resembles in sculpture pattern *Pleuroliria tenagos* Gardner from the Shoal River formation of Florida. The Shoal River species is decidedly larger, and the details of the sculpture pattern are distinct. The Chickasawhay species is known only from the holotype and the external mold of a larger specimen from the Chickasawhay River. With the extremities of the shell and the nuclear characters and those of the anterior canal unknown, it is not possible to be sure of the generic determination.

Occurrence.—Lower part of Chickasawhay marl. MISSISSIPPI: Station 14204, lower bed over Taylor Mill Creek, 1½ miles north of Waynesboro; station 14349, glauconitic marl on Chickasawhay River, one-fourth mile downstream from bridge, on Waynesboro-Laurel road, 2½ miles west of Waynesboro, Wayne County.

Genus FUSITURRICULA Woodring
FUSITURRICULA WAYNESBOROENSIS
Mansfield, n. sp.
Plate 27, figure 4

Species described from a single incomplete and crushed specimen. Apical portion of spire lost. Shell known only from the two high, latest whorls of the spire and the slender body smoothly tapering into the long and slender canal. Both spire and body undulated by strong, full, well-rounded ribs extending from the deep anal fasciole forward to the suture. Fasciole closely appressed against the preceding whorl, feebly waved by its axials, with an ill-defined sutural cord and obscure scratches on the depressed area. Siphonal notch broad and U-shaped, symmetrically placed on the fasciole. Low spiral fillets with intercalated lirae developed on the anterior and medial portions of the whorl and the base of the body and the canal. Outer lip incomplete, but, judging by the growth lines, expanding between the fasciole and the canal.

Incomplete holotype (U. S. Nat. Mus.

498461) measures: Height, 27.5 mm; diameter, 10.5 mm. From lower part of Chickasawhay marl at station 14204, Taylor Mill Creek, lowest bed at bridge, 1½ miles north of Waynesboro, Wayne County, Miss.

Fusiturricula waynesboroensis is more slender than *F. lapenotierei* (Dall) from the Tampa limestone, the axials are fewer and more inflated, the fasciole not so wide and less sharply defined, and the spiral sculpture less strong and regular.

The type is unique.

FUSITURRICULA sp. cf. F. SERVATA
(Conrad)
Plate 27, figure 7

The mold of a shell closely allied to the Vicksburg species *Fusiturricula servata* (Conrad) was recovered from the lower Chickasawhay at station 6753, Weaver Chute, on the east side of Conecuh River, Escambia County, Ala. The ribs do not seem to spread so much in the Alabama form, and the sutural cord is less pronounced than in that from Vicksburg, but the other characters indicated in the mold seem very close to those of Conrad's species. The length of the mold (U.S.N.M. 498462) from the tip to the base of the body is about 30 mm.

FUSITURRICULA? sp.
Plate 27, figure 26

The external mold of a shell which may be a *Fusiturricula* and which recalls in a general way *Fusiturricula condominia* (Dall) and others of the genus from the Tampa limestone was collected from the lower part of the Chickasawhay marl at station 13396, near the middle of sec. 25, T. 9 N., R. 7 W., Wayne County, Miss. The ribs of the species are relatively few and more sharply pinched than in *F. condominia* or in any of its subspecies, and the outline is more slender than in *F. lapenotierei* (Dall). *Pleurotoma anita* Aldrich from the Red Bluff clay has a somewhat similar sculpture, but it is a less slender shell than that from Wayne County, and the spirals are more elevated. The length of the mold (U.S.N.M. 498463) is about 20 mm, but this is probably not more than two-thirds of the length of the original shell. The maximum diameter is about 10 mm. The species is known from the single incomplete mold.

Genus TROPISURCULA Casey
TROPISURCULA sp. cf. T. CASEYI
(Aldrich)
Plate 27, figure 3

External molds from the lower part of the Chickasawhay marl at station 14323, the highest fossiliferous bed in a ravine 200 yards south-southwest of Jones' old plantation house, about one mile northwest of Glendon station, Clarke County, Ala., are very close to the genotype of *Pleurotoma* (*Drillia*) *caseyi* Aldrich, described from Red Bluff and recorded also from Byram and Vicksburg, Miss. The axials seem a little fuller and the spirals stronger and more elevated in the Clarke County species, but the two forms are closely related. The Byram form is recorded, too, from station 7211, on the east bank of Murder Creek, about 3 miles north of Castleberry, Conecuh County, Ala.

Figured mold (U. S. Nat. Mus. 498466) measures: Height, 12.5 mm; diameter, 3.6 mm.

Genus HEMIPLEUROTOMA Cossmann
HEMIPLEUROTOMA? sp.
Plate 27, figure 30

A single imperfectly preserved external mold (U.S.N.M. 498464) from the glauconitic marl near the base of the Chickasawhay River section may be referable to the genus *Hemipleurotoma* and apparently represents a new species. The form is relatively stout for the group, stouter than *Gemmula amica* Casey from the Red Bluff clay. There is a beaded double spiral on the anterior part of the whorl, and the beaded sutural cord is double on the final whorls. The axis of the fasciolar sinus follows the duplex anterior spiral, and the well-marked depression between the two pairs of spirals is crossed by retractive growth lines, indicating the posterior arm of the sinus. In the short interval between the anterior spirals and the inconspicuous suture the growth lines are protractive. The primary spirals on the medial and basal portions of the body are beaded, and so are the fine, symmetrically disposed secondaries. The pillar threads and those on the slightly bulging anterior fasciole are somewhat irregular in elevation and hackled by the intersecting growth lines. In none of

the other observed Oligocene or Miocene species is the growth sculpture on the medial and basal parts of the body so strong that it beads the spirals as in the Chickasawhay specimen.

The mold measures about 13 mm in height. It is from the lower part of the Chickasawhay marl at station 14349, about one-fourth mile downstream from the bridge over the Chickasawhay River, 2½ miles west of Waynesboro on State Highway 22.

Genus SYNTOMODRILLIA Woodring
SYNTOMODRILLIA? sp. cf. S.? TANTULA
(Conrad)
Plate 27, figure 15

A single small crushed specimen from the lower part of the Chickasawhay marl at station 14204, the lower bed at the bridge over Taylor Mill Creek, 1½ miles north of Waynesboro, Wayne County, Miss., is apparently closely related to *Syntomodrillia? tantula* (Conrad), from the Byram marl. The type of *Syntomodrillia* Woodring is *Drillia lissotropis* Dall, Recent in the West Indies. The nucleus of *lissotropis* and of generically related Recent and Bowden species includes only about two whorls; that of the Oligocene *tantula*, between three and four. The nucleus of the Chickasawhay individual is similar to topotypic nuclei of *S. tantula*. The sculpture patterns of the Chickasawhay individual and the Vicksburg forms are similar, and the lower number of postnuclear whorls and the higher apical angle of the Chickasawhay specimen may be due to immaturity and, perhaps, in part to crushing.

The figured individual (U. S. Nat. Mus. 498965) measures: 5.9 mm in height.

Genus SCOBINELLA Conrad
SCOBINELLA TAYLORENSIS
Mansfield, n. sp.
Plate 27, figures 14, 31

Shell small, subfusiform, the body whorl evenly tapering into the slender anterior canal, the greatest diameter near the median horizontal. Initial turn of the three-whorled protoconch largely immersed, the two succeeding volutions relatively high and smooth. The six and one-half to seven postnuclear whorls both axially and spirally sculptured, closely appressed, separated by an inconspicuous suture line. Anal fasciole sunken, moderately wide, a strong, beaded spiral slightly in front of the axis of the broad and deeply U-shaped incrementals that indicate the former position of the sinus. Axials rounded, separated by narrow, deeply trenched interaxials, bisected by an incised spiral, protractive in front of the fasciole, suppressed upon the fasciole but continued behind it in the form of the obscurer retractive nodes on the feeble sutural cord. Whorls shouldered by the abrupt posterior terminations of the ribs, which, on the body, are reduced to peripheral nodes becoming obsolete toward the aperture. Sides and base of body girdled with about seven strong fillets separated by channels of approximately the same width as the spirals; the long, straight pillar closely threaded. Aperture narrow, angulated posteriorly, incomplete in all of the available specimens. Pillar folds oblique, stronger posteriorly, varying from two to four or possibly more in number.

Holotype (U. S. Nat. Mus. 498467) measures: Height, 15 mm; diameter (aperture incomplete), 6 ± mm. Paratype (U. S. Nat. Mus. 498468) measures: Height of incomplete individual, 11.5 mm; diameter (aperture incomplete), 5 ± mm. From lower part of Chickasawhay marl at station 14204, lower bed at bridge over Taylor Mill Creek, 1½ miles north of Waynesboro, Wayne County, Miss.

The species is known only from four more or less imperfect shells from the type locality and from an external mold from Rocky Creek, which is probably conspecific. *Scobinella* collected at station 14368, Jay Branch, Monroe County, Ala., are more slender than *S. taylorensis* but otherwise similar. *Scobinella caelata* Conrad, described from Vicksburg, is similar in general sculpture pattern, though it is a larger, coarser shell with more prevalent beading. The mid-American species *Scobinella magnifica* Gabb from the Bowden, *Eucheilodon morierei* (Laville ms.) Cossmann from the Gatun, and *Scobinella tristis* Pilsbry and Johnson from the Miocene of the Dominican Republic are all relatively large, averaging at least three times the size of *taylorensis* and are more elaborately decorated. There is no record of the genus in the Tampa limestone

nor in the Alum Bluff group. Woodring in discussing the geologic range of *Scobinella* has observed (1928, p. 199) that

> *Scobinella* is another Eocene and Oligocene genus that survived until Miocene time in the West Indian region. In the United States, no species are known later than upper Oligocene. The last surviving Miocene species are the largest of all.

The record of *Scobinella* in the lower Chickasawhay is, then, an important bit of evidence for the pre-Miocene age of the lower Chickasawhay, and the likeness of the form to the Vicksburg species *caelata* speaks for an upper Oligocene age.

Occurrence.—Lower part of Chickasawhay marl. MISSISSIPPI: Station 14204, lower bed at bridge over Taylor Mill Creek, 1½ miles north of Waynesboro; station 13240?, sec. 18, T. 8 N., R. 5 W., 100 feet east of center on Rocky Creek, Wayne County.

Genus CANCELLARIA Lamarck

Subgenus BONELLITA Jousseume

CANCELLARIA (BONELLITIA) WAYNENSIS Mansfield, n. sp.

Plate 27, figure 19

Shell, small, ovate, rather fragile. Nuclear whorls lost; a little less than four complete postnuclear turns remaining; whorls of the spire low, broadly inflated and rapidly increasing in diameter, closely appressed, the suture line crenulated by the axials of the preceding volution; body relatively large, axials rounded, moderately elevated, feebly retractive, uniform in strength except on the final half of the body whorl, where the ribs tend to be varicose and irregular; 14 in number on the penultima. Spirals low, flattened, the two anterior paired on the whorls of spire, the medial reduced to a narrow thread, the posterior pair more widely spaced than the anterior, and behind them and very close to the suture, another threadlet; suture slipping forward a little toward the aperture, disclosing an additional spiral in front of the anterior pair and similar to them; body whorl with 13 primary bands; interspiral spaces grated by the incrementals, and in some, but not in all of them secondary spirals. Columella short, twisted, triplicate, the anterior fold formed by the sharpened and twisted margin of the pillar; 2 low, intermediate tubercles on the pillar, in line with the extremities of the folds. Shell depressed behind the pillar but not umbilicate. Aperture imperfect, apparently of moderate width, terminating anteriorly in an obscure spout with splayed margins.

Imperfect holotype (U. S. Nat. Mus. 498469) measures: Height, 11 mm; diameter, 6.7 mm. From lower part of Chickasawhay marl at station 14204, lowest bed at bridge over Taylor Mill Creek, 1½ miles north of Waynesboro, Wayne County, Miss.

Cancellaria waynensis recalls in a general way *C. mississippiensis* Conrad from Vicksburg, but the Byram marl species is a stouter shell with a deeper sutural channel and more vigorous sculpture, both axial and spiral. Some of the Alum Bluff species, such as *Cancellaria desmotis* Gardner, have something of the same general aspect, but in the adult stage they are narrowly umbilicate.

The type is unique.

Subgenus TRIGONOSTOMA Blainville

CANCELLARIA (TRIGONOSTOMA) sp.

Plate 27, figure 29

Incomplete external molds of *Cancellaria* (*Trigonostoma*) may represent a single species or two related forms, possibly of the group of *C.* (*Trigonostoma*) *subthomasiae* Dall from the Tampa limestone of Florida. The Tampa species is more angular than the shells indicated by the Alabama molds, and the shoulder is wider on the Florida form. They have in common, however, a sculpture of numerous narrow, sharply elevated, retractive riblets overridden by strong, even spiral threading. The body and the final whorl of the spire of the figured specimen (U.S.N.M. 498470) are about 15 mm high. The locality is station 14322, the uppermost fossiliferous bed on the north side of Salt Creek, Clarke County, Ala. A similar, but possibly not identical, species occurs at station 14287 at the waterfall of Patton Creek, one-fourth mile above Highway 45, 1½ miles east of Waynesboro, Wayne County, Miss.

Genus OLIVELLA Swainson

OLIVELLA sp. cf. O. AFFLUENS Casey

Plate 27, figure 16

One small nearly perfect shell closely allied to *Olivella affluens* Casey, 1903, was collected from the lower part of the Chickasawhay marl at station 14204, the lower

bed at the bridge over Taylor Mill Creek, 1½ miles north of Waynesboro, Wayne County, Miss. The shell is immature, but it exhibits the large nucleus which characterizes *affluens* Casey in contrast to that of another Vicksburg species, *Olivella mississippensis* (Conrad).

The figured specimen (U. S. Nat. Mus. 498471) measures: Height, 8.7 mm; diameter, 3.5 mm.

A crushed adult body whorl apparently referable to the same species occurs with the adolescent. The genus is indicated also by an internal mold from the lower part of the Chickasawhay marl from station 14362, the glauconitic marl near the base of the section about one-fourth mile downstream from the bridge over the Chickasawhay on the Laurel-Waynesboro road, 2½ miles west of Waynesboro, Wayne County, Miss.

Genus Lyria Gray

Lyria sp. cf. L. mississippiensis (Conrad)

Plate 27, figure 41

A single incomplete external mold (U.S.-N.M. 498472) of a shell, referable in all probability to *Lyria*, was collected from the lower part of the Chickasawhay marl at station 14205a, a hard ledge in a stream, a quarter of a mile north of Perdue Hill, Monroe County, Ala. The species seems identical with that recorded from the Suwannee limestone (Mansfield, 1937, p. 108, pl. 3, fig. 3) under the name of *Lyria mississippiensis* Conrad? Both the Suwannee individual and that from Perdue Hill are more closely ribbed than either the usual *Lyria mississippiensis* Conrad from the Byram marl at Vicksburg, Miss., or *L. nestor* Casey from the Red Bluff on Carson's Creek, Wayne County, Miss., and probably represent an undescribed form. Dall (1890, p. 85, pl. 6, fig. 2) figured the Red Bluff species under the name of *L. costata* Sowerby, a rare shell described by Sowerby from the Barton beds, upper Eocene, of southern England. The example of the British species in the collections of the U. S. National Museum is a larger shell than the majority of the Gulf individuals; the whorls are higher and more rounded; the aperture narrower and less oblique, and the outer lip less constricted in front.

It is probable that the strong superficial likeness of the upper Eocene shell of southern England to the upper Oligocene form from the Gulf province of North America is a case of parallel development within a compact but sensitive group in which the generic characters are strongly marked, and the species from different time levels present slight but constant differences.

The height of the shell from Perdue Hill was probably about 15 mm and the diameter about 9 mm.

Genus Latirus Montfort

Latirus taylorensis Mansfield, n. sp.

Plate 27, figures 1, 2, 9

Nucleus smooth, buccinoid, of three and one-half to four rapidly enlarging volutions. Initial four or five axial riblets narrow, feebly arcuate, close-set, persisting from suture to suture with fairly uniform strength, overridden by three or four fine, equal and equispaced spirals; sculpture change at the close of about a quarter turn, the axials becoming fewer and more spreading and tending with the strong development of the sutural cord to become obsolete posteriorly. Sculpture on adult whorls of bulging, undulatory axials, not more than eight to the whorl, strongest peripherally and dying out on the excavated area in front of the suture. Initial spirals broadening and flattening, commonly three on the medial portion of the whorl with a fourth, not quite so wide, in front of the impressed posterior suture, and a fifth almost or entirely concealed by the anterior suture, which is wound upon it; one to three secondaries and tertiaries intercalated between each pair of primaries, with additional spirals on the posterior fasciole and on the pillar. Canal rather long and sculptured with alternating primary and secondary threads. Probably three columellar folds, the anterior not far behind the entrance to the canal, the angle to the axis of the shell increasingly high toward the aperture.

Estimated height of three largest syntypes (U. S. Nat. Mus. 498474) 45 mm. From lower part of the Chickasawhay marl at station 14204, lowest bed at bridge over Taylor Mill Creek, 1½ miles north of Waynesboro, Wayne County, Miss.

There is no single specimen that is entire,

but the characteristics of the shell can be determined by the synthesis of the incomplete syntypes. One of them includes the nuclear and three postnuclear whorls, a second, the middle and later whorls of the spire, and the third, the body and pillar.

Latirus taylorensis has much in common with *Latirus protractus* (Conrad) from the Byram marl. The nucleus is larger on the Chickasawhay species, the apical angle apparently higher, and tertiary spirals are commonly introduced between the primary and the intercalated secondary, a sculpture detail which has not been observed in *L. protractus*.

Latirus taylorensis is known from the type locality alone.

Genus FASCIOLARIA Lamarck
FASCIOLARIA sp. cf. F. PETROSA Dall
Plate 27, figure 17

Fragments (U.S.N.M. 498473) too incomplete for identification retain no characters by which they can be separated from *Fasciolaria petrosa* Dall (1915, p. 64, pl. 6, fig. 7) described from the Tampa limestone at Ballast Point. The form is not rare at the single locality at which it occurs, station 14364, the upper part of the section on the Chickasawhay River, one-fourth mile below the bridge on the Waynesboro-Laurel road, 2½ miles west of Waynesboro, Wayne County, Miss.

Its horizon is the upper part of the Chickasawhay marl, the probable time equivalent of the Tampa limestone.

Genus MELONGENA Schumacher
MELONGENA sp.
Plate 27, figure 27

Rather large specimens preserved as incomplete internal or external molds occur at several localities and seem to represent the same or closely related species. The external mold (U.S.N.M. 498475) from the Chickasawhay marl, station 14288, Rocky Branch, 1 mile north-northeast of Denham, Wayne County, Miss., which has been reproduced in the figure, shows the greater part of the spire. It is high for the genus and includes more than 5 whorls. The feebly concave, spirally lirate shoulder occupies ar least two-thirds of the height of the whorl. The peripheral tubercles are narrow but very prominent and knob-like and number probably eight to ten to the whorl. This specimen may be closely related to an unnamed species from the Suwannee limestone at station 12758, the Camp Concrete Rock quarry, 5.9 miles northeast of the courthouse at Brooksville, and at station 12761, along the highway, 2 miles north of Hudson, stations in Hernando and Pasco Counties, Fla. The tubercles seem less prominent, however, on the Suwannee species, and the shoulder ramp less wide relatively. The spire of the figured specimen from the Chickasawhay measures not far from 50 mm in height.

Other indeterminate molds occur at the following localities: Station 14287, Patton Creek, waterfall one-fourth mile above Highway 45, 1½ miles east of Waynesboro; station 6649, southwest bank of Chickasawhay River, 2½ miles south of Waynesboro; stations 14508, 14508a, beds 3 and 4 on Bucatunna Creek, about 200 yards below Steep Hill Branch, Wayne County, Miss.

Genus TRITIARIA Conrad
TRITIARIA sp.
Plate 27, figure 20

Shell rather small and slender, including between three and four smooth, rapidly enlarging nuclear and five sculptured postnuclear whorls, closely appressed and separated by sutures crenulated by the axials of the preceding whorl. Axials narrow, rounded, 10 or 12 to the whorl, for the most part fairly uniform in elevation but with an occasional varicose rib. Primary spirals flattened, three to four on the whorls of the spire with four of five intermediate secondary lirae crowded between each pair of primaries; body whorl closely threaded with primaries, secondaries and tertiaries. Shell so crushed that apertural characters are not known.

Figured specimen (U. S. Nat. Mus. 498476) 11.5 mm high, apparent diameter increased by crushing. From station 14204, lowest bed at bridge over Taylor Mill Creek, 1½ miles north of Waynesboto, Wayne County, Miss.

Tritiaria waynensis Mansfield from the same locality has a larger apical angle, the axial ribs are not so narrow, and the very fine secondary and tertiary spiral threading is not developed. Both the axial and spiral

sculpture of the figured species are more sharply defined than in *Tritiaria mississippiensis* (Conrad), the genotype from Vicksburg, and the shell is more slender.

Occurrence.—Lower part of Chickasawhay. ALABAMA: Station 6735, Murder Creek at the bridge east of Castleberry, Conecuh County, (molds); station 10334, one-fourth mile northeast of Perdue Hill, Monroe County (molds); station 14323, 1 mile northwest of Glendon, Clarke County (molds). MISSISSIPPI: Station 13239, Buca-

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EXPLANATION OF PLATE 25

FIGS. *1, 2—Anadara macneili* Mansfield. *1.* Left valve, U. S. Nat. Mus. 498673, ×1½. *2.* Left valve, U. S. Nat. Mus. 498674, ×1½. (p. 176)

3—Barbatia cf. *B. cuculloides* Conrad. Right valve, U. S. Nat. Mus. 498514, ×1. (p. 175)

4—Glycymeris cf. *G. suwanneensis* Mansfield. Left valve, U. S. Nat. Mus. 498511, ×1. (p. 174)

5—Barbatia cf. *B. marylandica* Conrad. Left valve, U. S. Nat. Mus. 498513, ×1. (p. 175)

6, 8—Anadara mummi Mansfield. *6*, Left valve, U. S. Nat. Mus. 498675, ×2. *8*, Right valve, U. S. Nat. Mus. 498676, ×1½. (p. 175)

7—Pteria cf. *P. argentea* Conrad. Right valve, U. S. Nat. Mus. 498516, ×½. (p. 178)

9, 10, 18—"Venericardia" waynensis Mansfield, n. sp. *9*, Paratype, left valve, U. S. Nat. Mus. 498539, ×1½. *10, 18*, Holotype, right valve, U. S. Nat. Mus. 498538, ×1. (p. 189)

11—Barbatia (*Acar*) cf. *B.* (*Acar*) *domingensis* (Lamarck). Right valve, U. S. Nat. Mus. 498515, ×2. (p. 175)

12. Diplodonta (*Sphaerella?*) *waynensis* Mansfield, n. sp. Left valve of paired valves of holotype, U. S. Nat. Mus. 498545, ×1½. (p. 193)

13, 14—Anomia taylorensis Mansfield, n. sp. Holotype, left valve, U. S. Nat. Mus. 498532 ×1. *14*, Paratype, left valve, U. S. Nat. Mus. 498533, ×½. (p. 184)

15—Diplodonta cf. *D. alta anclotensis* Mansfield. Internal mold of double valves, U. S. Nat. Mus. 498544, ×1. (p. 192)

16, 17—Crassinella sp. *16*, Left valve, U. S. Nat. Mus. 498537, ×2½. *17*, Left valve, U. S. Nat. Mus. 498537, ×2½. (p. 189)

19—Macrocallista (*Chionella?*) *perduensis* Mansfield, n. sp. Topotype, left valve, U. S. Nat. Mus. 498553, ×¾. (p. 196)

20, 21—Myrtaea (*Myrtaea*) *taylorensis* Mansfield, n. sp. Exterior and interior of syntype, right valve, U. S. Nat. Mus. 498540, ×2. (p. 191)

22—Macrocallista (*Chionella?*) cf. *M.* (*Chionella?*) *sobrina* Conrad. Right valve, U. S. Nat. Mus. 498550, ×¾. (p. 196)

23—Miltha cf. *M. chipolana* Dall. Fragment of right valve, U. S. Nat. Mus. 498541, ×1. (p. 191)

24, 26—Nuculana (*Sacella?*) *taylorensis* Mansfield, n. sp. *24*, Holotype, left valve, U. S. Nat. Mus. 498509, ×2. *26*, Paratype, right valve, U. S. Nat. Mus. 498510, ×2. (p. 172)

25—Nuculana waynensis Mansfield, n. sp. Holotype, left valve, U. S. Nat. Mus. 498508, ×2. (p. 172)

27, 28—Nemocardium diversum waynense Mansfield, n. subsp. Profile, ×1½ and side view, ×1, of holotype, right valve, U. S. Nat. Mus. 498547. (p. 195)

29, 32, 37—Corbula (*Caryocorbula*) *taylorensis* Mansfield, n. sp. Syntypes, U. S. Nat. Mus. 498559, ×2½. (p. 200)

30, 31—Macrocallista (*Chionella?*) *perduensis* Mansfield, n. sp. *30*, Syntype, left valve, U. S. Nat. Mus. 498552, ×¾. *31*, Syntype, right valve, U. S. Nat. Mus. 498551, ×¾. (p. 196)

33—Divaricella sp. Left valve, U. S. Nat. Mus. 498543, ×1½. (p. 192)

34, 45—Cardium cf. *C.* (*Cerastoderma*) *phlyctaena* Dall. Profile and side view of left valve, U. S. Nat. Mus. 498549, ×1. (p. 195)

35—Miltha? hernandoensis Mansfield. Left valve, U. S. Nat. Mus. 498542, ×½. (p. 192)

36—Glycymeris sp. Right valve, U. S. Nat. Mus. 498678, ×2. (p. 174)

38—Cardium (*Trachycardium?*) sp. A. Left valve, U. S. Nat. Mus. 498548, ×1. (p. 193)

39—Thracia (*Cyathodonta*) *taylorensis* Mansfield, n. sp. Holotype, right valve, U. S. Nat. Mus. 498535, ×1. (p. 187)

40—Brachidontes mississippiensis (Conrad). Left valve, U. S. Nat. Mus. 498534, ×1. (p. 176)

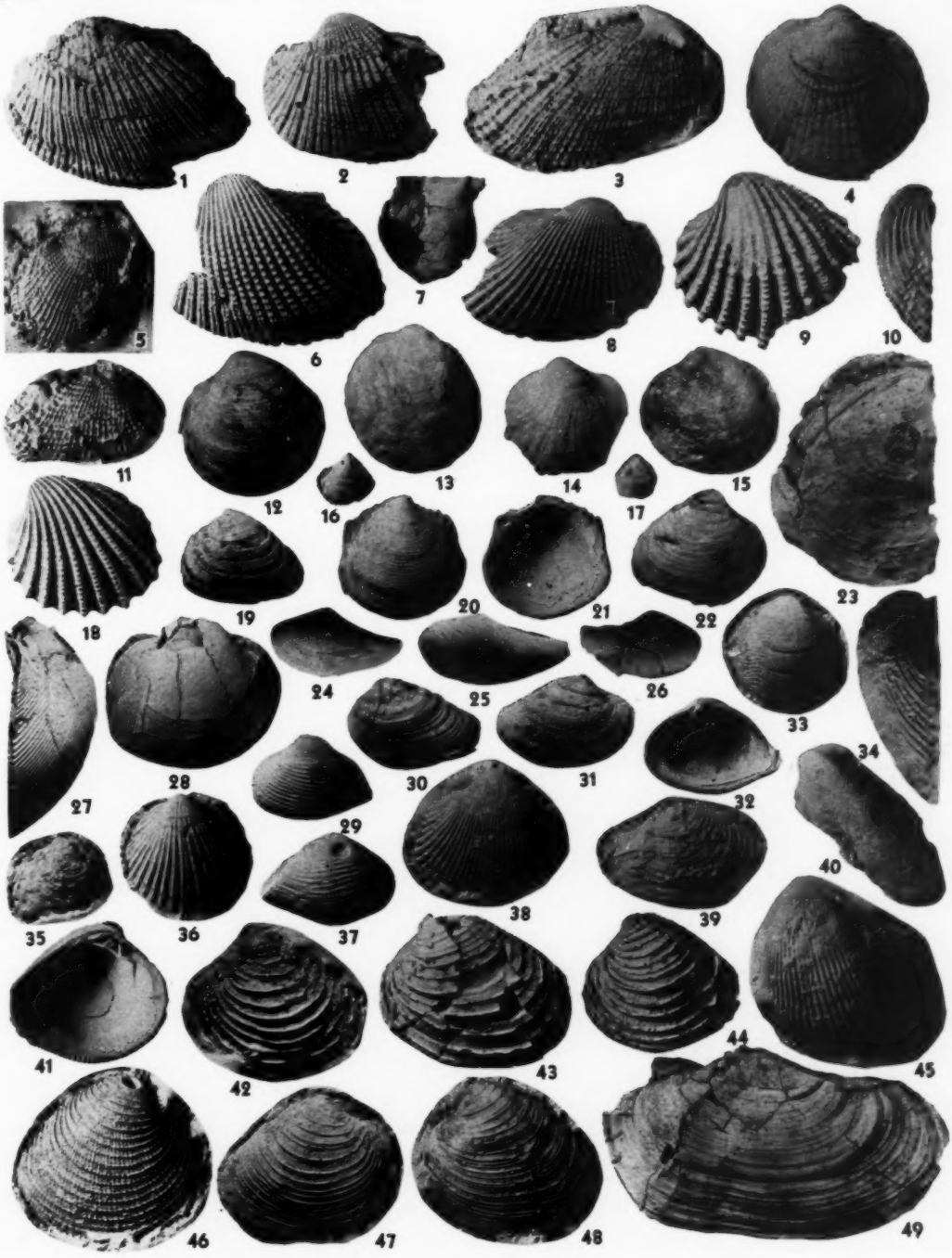
41, 42, 44—Chione perduensis Mansfield, n. sp. *41. 44*, Holotype, left valve, interior and exterior, U. S. Nat. Mus. 498555, ×1. *42*, paratype, left valve, U. S. Nat. Mus. 498556, ×¾. (p. 198)

43—Chione sp. Left valve, U. S. Nat. Mus. 498558, ×1½. (p. 199)

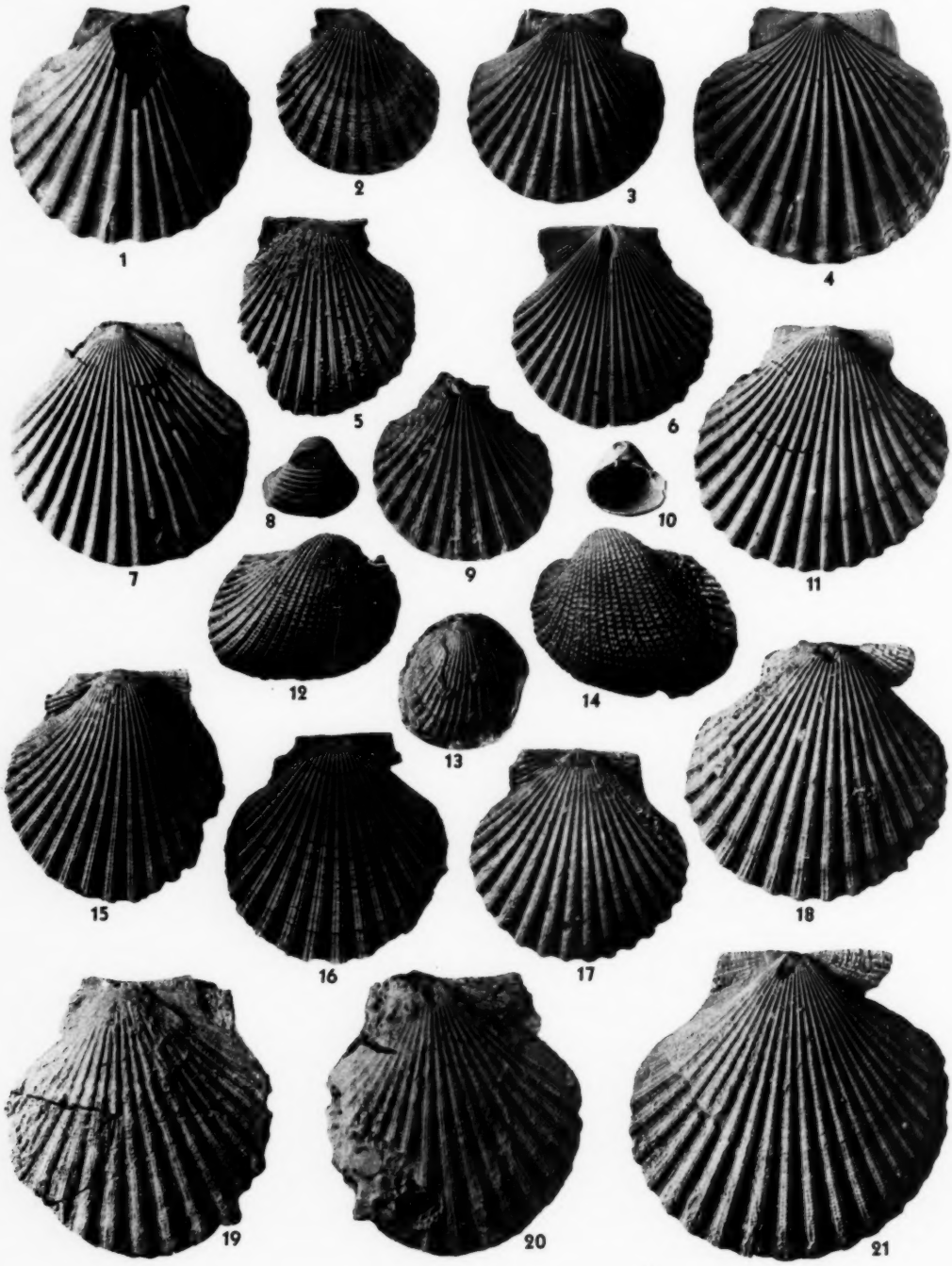
46—Chione bainbridgensis Dall. Right valve, U. S. Nat. Mus. 498554, ×1. (p. 197)

47, 48—Chione catunna Mansfield, n. sp. Syntypes, right and left valves, U. S. Nat. Mus. 498557, ×1. (p. 199)

49—Panope taylorensis Mansfield, n. sp. Holotype, left valve, U. S. Nat. Mus. 498561, ×½. (p. 200)



Mansfield, Chickasawhay Mollusks



Mansfield, Chickasawhay Mollusks

tunna Creek, NW¼ sec. 17, T. 8 N., R. 5 W.; station 13240, Rocky Creek, sec. 18, T. 8 N., R. 5 W., 100 feet east of center (molds); station 13396, hillside above mouth of Limestone Creek, near middle of sec. 25, T. 9 N., R. 7 W. (molds); station 14204, lowest bed at bridge over Taylor Mill Creek, 1½ miles north of Waynesboro; station 14349, Chickasawhay River, glauconitic bed near base of section, one-fourth mile downstream from bridge, 2½ miles west of Waynesboro on road to Laurel, Wayne County.

TRITIARIA WAYNENSIS Mansfield, n. sp.
Plate 27, figure 12

Shell rather small, acutely tapering, including three and one-half to four smooth rapidly enlarging nuclear whorls and four sculptured postnuclear whorls, closely appressed and separated by sutures which are crenulated by the axials of the preceding whorl. Axials, 10 to 12 on the whorls of the spire, strong, well-rounded, extending from suture to suture and offset on contiguous whorls. Spirals flattened, alternating in strength with an occasional lira of the third order introduced. Body constricted basally, depressed slightly behind the raised margin of the fasciole. Fasciole expanded, lirate, emarginate, the sharp margin at the base of the body forming the posterior arm of the terminal notch.

Holotype (U. S. Nat. Mus. 498477) measures: Height, 8 mm; diameter, 4 mm. From lower part of Chickasawhay marl at station 14204, lowest bed at bridge over Taylor Mill Creek, 1½ miles north of Waynesboro, Wayne County, Miss.

Tritiaria waynensis differs from the genotype, *T. mississippiensis* (Conrad), in the shorter, less slender shell, more closely spaced and heavier axials, and in the wider primary spirals. The unnamed species of *Tritiaria* which occurs with *T. waynensis* is a more elevated and slender shell with a more elaborate development of delicate lirae crowding the spaces between the primary spirals.

The species is known only from a few imperfect shells from the type locality.

TRITIARIA sp. cf. T. VICKSBURGENSIS (Aldrich)
Plate 27, figure 40

Specimens preserved as external molds at two localities seem to be closely related to each other and to *Tritiaria vicksburgensis* (Aldrich) described from the Oligocene at Vicksburg, Miss. They have in common a sculpture of heavy rippled, retractive axials and alternating narrow and relatively wide spiral lirae. The molds indicate however, a rather more slender shell than that of *T. vicksburgensis*.

The height of the figured mold (U. S. Nat. Mus. 498492) of the body whorl is about 9 mm. From lower part of Chickasawhay

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EXPLANATION OF PLATE 26

FIGS. *1, 3, 4—Chlamys* (*Plagioctenium*) *howei* Mansfield, n. sp. ×¾. *1*, Right valve, U. S. Nat. Mus. 498519. *3*, Paratype, right valve, U. S. Nat. Mus. 498518. *4*, Holotype, left valve, U. S. Nat. Mus. 498517. (p. 178)

2—Chlamys sp. Left valve, U. S. Nat. Mus. 498531, ×1. (p. 184)

5—Chlamys aff. *C. duplex* (Cooke) Right valve, U. S. Nat. Mus. 498530, ×¾. (p. 184)

6, 16—Chlamys (*Aequipecten*) *chickaria* Mansfield, n. sp. *6*, Left valve, U. S. Nat. Mus. 498529 ×1½. *16*, Holotype, right valve, U. S. Nat. Mus. 498528, ×1. (p. 183)

7, 11—Chlamys (*Plagioctenium*) *mcguirti* Mansfield, n. sp. Syntypes, ×1. *7*, Left valve, U. S. Nat. Mus. 498521. *11*, Right valve, U. S. Nat. Mus. 498520. (p. 180)

8, 10—Corbula (*Corbula*) *laqueata* Casey?. Exterior and interior of right valve, U. S. Nat. Mus. 498560, ×3½. (p. 199)

9, 19, 20—Chlamys (*Aequipecten*) *gainestownensis* Mansfield, n. sp. *9*, Paratype, left valve, U. S. Nat. Mus. 498523, ×½. *19, 20*, Holotype, left and right paired valves, U. S. Nat. Mus. 498522, ×¾. (p. 181)

12, 14—Anadara mummi Mansfield. Right and left valves, U. S. Nat. Mus. 498677, ×2. (p. 175)

13—Glycymeris sp. Left valve, U. S. Nat. Mus. 498512, ×1½. (p. 174)

15, 21—Chlamys (*Aequipecten*) *glendonensis* Mansfield, n. sp. *15*, Left valve, U. S. Nat. Mus. 498525, ×1½. *21*, Holotype, right valve, U. S. Nat. Mus. 498524, ×1½. (p. 182)

17, 18—Chlamys (*Aequipecten*) *waynesis* Mansfield, n. sp. Syntypes ×1½. *17*, Left valve, U. S. Nat. Mus. 498527. *18*, Right valve, U. S. Nat. Mus. 498526. (p. 182)

marl at station 7166, Tombigbee River, east bank, just south of Payne's Hammock, Clarke County, Ala.; bed no. 3 of the measured section.

Another locality is station 6758, on the south bank of Yellow River, at Watson [Watkins] and Henderson wagon bridge, 4 miles north of the Florida line in Covington County, Ala.

Genus ALECTRION Montfort

The type of *Alectrion* Montfort, *Buccinum papillosum* Linnaeus, is an Indo-Pacific species superspecifically unlike the East Coast American Tertiary forms which have been referred to *Alectrion*. The nassoid molds from the Chickasawhay marl have not retained the characters necessary to determine the smaller superspecific groups into which the shells formerly called "*Alectrion*" are now divided.

"ALECTRION" sp. A
Plate 27, figure 28

Shell stout and subovate. Nucleus not preserved. Postnuclear whorls at least five in number, rapidly increasing in diameter, narrowly tabulated posteriorly. Axials running 12 to 15 to the whorl, narrow and clearly defined, almost vertical, overridden by the spirals, which cancellate them. Spirals four on the later whorls of the spire, probably about twice as many on the body, flattened, inclined to be nodose at the intersection with the axials; quadrate areas included between the axials, and the spirals wider than they are high. Body apparently constricted into a rather wide, lirate, deeply emarginate fasciole.

Figured specimen (U. S. Nat. Mus. 498493) measures: Height, 14 mm; diameter, 8 mm. From lower part of Chickasawhay marl at station 14282, 3 miles north of Waynesboro, from a fallen block of limestone along the roadside near Limestone Creek, Wayne County, Miss.

The second species questionably referred to "*Alectrion*" differs in the more rounded, less tabulated whorls of the spire, the less inflated body, less strongly constricted at the base, and the less evenly cancellate surface sculpture.

Occurrence.—Lower part of Chickasawhay marl. ALABAMA: Station 14322, highest fossiliferous bed in section on north side of Salt Creek, on road from Jackson to Rockville, Clarke County. MISSISSIPPI: Station 14282, fallen block of limestone along roadside near Limestone Creek, 3 miles north of Waynesboro; station 14283, hilltop above roadside and probably the source of the fallen block, near Limestone Creek, 3 miles north of Waynesboro, Wayne County.

"ALECTRION?" sp. B
Plate 27, figure 11

Molds which in general outline and sculpture pattern resemble "*Alectrion*" sp. A occur in the lower part of the Chickasawhay marl at station 13240, Rocky Branch, sec. 18, T. 8 N., R. 5 W., 100 feet east of the center of the section. They are not planed at the shoulder like the specimens of "*Alectrion*" sp. A, and the ribs are not so narrow. Apparently, too, the anterior canal is appreciably longer, and it is possible that the species should be referred to *Tritiaria* rather than to "*Alectrion*".

The length of the body of the figured mold (U. S. Nat. Mus. 498494) is 8.5 mm, the diameter, 6.5 mm.

"*Alectrion*" may be represented by molds which are fairly common at station 14519, an old road on the east side of the new road, south of Limestone Creek, about halfway up the hill, Wayne County, Miss., but the sculpture in most of the individuals looks muricoid rather than nassoid. One mold, however, strongly resembles the molds of "*Alectrion*" sp. B.

Genus METULA H. and A. Adams
METULA TAYLORENSIS Mansfield, n. sp.
Plate 27, figure 32

Species known only from a single somewhat crushed and incomplete specimen. Apical portion lost; body and two last whorls of spire remaining. Shell small, slender, the whorls closely wound, separated by distinct sutures, which are not crenulated by the axial ribs. On the spire a narrow sutural band cut off by an incised groove, which dissects the axials, and a second groove developed in front of the first on the body. Axials narrow, flattened, weakly arcuate, closely spaced, probably 20 to 25 to each of the later whorls of the spire, rubbed off on the final half-turn of the body. Interaxials

angular, not so wide as the axials, grated evenly on the later whorls of the spire; vestigial grooves on the upper part of the final half turn of the body, but on the medial part becoming increasingly stronger, and developing anteriorly into a flattened cording; anterior fasciole closely lirate. Characters of aperture not well known. Outer lip flaring slightly. Margin of anterior fasciole broken, probably feebly sinuated.

Holotype (U. S. Nat. Mus. No. 498495), measures: Height of incomplete specimen 8.5 mm; diameter, 3.0 ± mm. From lower part of Chickasawhay marl at station 14204, lower bed at bridge over Taylor Mill Creek, 1½ miles north of Waynesboro, Wayne County, Miss.

Metula taylorensis seems to be closely related to *M. fragilis* Casey, from the "Upper Vicksburg marl" of Mississippi. The Chickasawhay species differs from Casey's *fragilis* in the smaller shell, and the nearly smooth area on the upper half of the final half turn. The close-set axial ribbing is characteristic of both species. In the two mid-American Miocene species, *Metula cancellata* Gabb from the Gurabo formation of the Dominican Republic and *Metula gabbi* Brown and Pilsbry from the Gatun formation of the Canal Zone, the spiral sculpture overrides the axial, and both the axial and the spiral threading are developed over the entire body.

The type is unique.

Genus MUREX Linnaeus
MUREX? species
Plate 27, figure 10

Ill-preserved and immature specimens from station 14204, the lowest bed at the highway bridge over Taylor Mill Creek, 1½ miles north of Waynesboro, Miss., may be referable to *Murex*. The shell is more slender, and the canal much longer than in *Murex mississippiensis* Conrad from the Oligocene Byram marl and in form is more suggestive of *M. rufirupicolus* Dall described from an internal mold from the Flint River formation near Bainbridge, Georgia. There are probably eight to ten strong axial ribs to the whorl and on the body these are unequal and intermittently varicose. The persistence of the axials to the posterior suture obscures the ill-defined shoulder ramp. Strong rounded spiral cords, regular in size and spacing alternate with secondary threads on the later whorls of the spire and on the body. Secondaries are not developed on the early whorls, and on the shoulder the coarse primary sculpture is absent. The characters of the aperture are not known. The length of the figured specimen (U. S. Nat. Mus. 498496) is probably between 17 and 18 mm, the diameter, 7 mm. Other specimens from the same locality and representing the same species are smaller.

At station 13239, NW¼ sec. 17, T. 8 N., R. 5 W., Bucatunna Creek, Wayne County, Miss., a second species of *Murex*, closer to *M. mississippiensis* in form and sculpture, is indicated by a mold of the exterior. A third species more strongly and regularly sculptured with laminar varices is represented by external molds from stations 14361 and 14349, the glauconitic bed near the base of the Chickasawhay River section, one-fourth mile downstream from bridge on State Highway 22, 2½ miles west of Waynesboro on the Laurel road, Wayne County, Miss. A related species may be represented by a mold from station 10334, Perdue Hill, Monroe County, Ala.

Genus RAPANA Schumacher
RAPANA sp. cf. R. VAUGHANI Mansfield
Plate 27, figure 51

A species of *Rapana* (U.S.N.M. 498497) similar in form and general sculpture pattern to *R. vaughani* Mansfield described from the Tampa limestone at River Junction, Gadsden County, Fla., was recovered from the lower part of the Chickasawhay marl at station 14349, the glauconitic bed near the base of the Chickasawhay River section, one-fourth mile downstream from the bridge on the highway from Waynesboro to Laurel, 2½ miles west of Waynesboro. The intermediate spirals in the Tampa species are thinner and sharper than in that from the Chickasawhay, and the number and arrangement of the primaries and secondaries differ in the two forms. The holotype of *R. vaughani* measures 25 mm in height and 18 mm in diameter. The figured Chickasawhay mold is not so large, but the dimensions are comparable to those of the Tampa holotype.

The same or a closely related species may be represented by poorly preserved molds

from station 14288, Rocky Branch, southwest corner of sec. 8, T. 8 N., R. 5 W., 1 mile north-northeast of Denham, Wayne County, Miss., and from station 10334, one-fourth mile northeast of Perdue Hill, Monroe County, Ala.

Genus SCALINA Conrad
SCALINA WAYNENSIS Mansfield, n. sp.
Plate 27, figure 34

Species known only from the holotype, an incomplete shell with the apical whorls missing and the aperture broken. Shell fragile, slender, the 10 remaining whorls very slowly increasing in diameter and separated by impressed sutures; whorls well-rounded medially, obliquely shouldered posteriorly. Spiral sculpture off our equi-sized and equi-spaced, somewhat flattened spirals, the posterior of the four outlining the shoulder margin; two less prominent lirae on the shoulder ramp. Axials incremental in character extending from suture to suture, not overriding the spirals but fine, sharp, and evenly spaced. Characters of the aperture and of the base of the body lost.

Holotype (U. S. Nat. Mus. 498498) measures: Height, 17 mm; diameter about 5 mm, but shell too much crushed to give accurate maximum. From lower part of Chickasawhay marl at station 14204, lowest bed at bridge over Taylor Mill Creek, 1½ miles north of Waynesboro, Wayne County, Miss.

Scalina waynensis is remarkable for the strength and uniformity in size and spacing of the primary spirals. There is nothing very close to it specifically. The genus is recorded from the Eocene to the Recent. The genotype *Scala* (*Scalina*) *staminea* Conrad is a Moodys marl (formerly called Gosport sand) species. The other species listed in Conrad's first mention of *Scalina* was *Scala* (*Scalina*) *trigintanaria* Conrad from the Vicksburg, a more finely sculptured cancellate shell than *Scalina waynensis*.

The holotype of *Scalina waynensis* is the only known example of the species.

SCALINA sp. cf. S. TRIGINTANARIA Conrad

Scalina trigintanaria Conrad was described from the Byram marl at Vicksburg, Miss. It is a rare shell of rather large size for the group with well-rounded whorls. A specimen in the U. S. National Museum compared by C. Wythe Cooke with the type in the Academy of Natural Sciences in Philadelphia is threaded on the later whorls with eight equal and equi-spaced, somewhat flattened lirae overridden with numerous fine, sharp, laminar axials, extending from suture to suture, bent sharply forward at the posterior suture and abutting against the preceding whorl. Specimens from station 6735, and station 14355, bed no. 5 of the Cooke (1926, p. 291) section on Murder Creek, east of Castleberry, Conecuh County, Alabama, are too poorly preserved for positive identification, but they exhibit the form and spiral sculpture of the Vicksburg species. The axial lamellae are less crowded on the Alabama specimens, and none of the specimens are so large as the examples of *S. trigintanaria* from Vicksburg.

Genus CASSIS Scopoli
CASSIS FLINTENSIS Mansfield, n. sp.
Plate 27, figures 47, 48?, 49

Cassis sulcifera Sowerby. DALL, *1916*, U. S. Nat. Mus., Proc., vol. 51, no. 2162, p. 508, pl. 86, fig. 4. Not SOWERBY, *1850*, Geol. Soc. London, Quart. Jour., vol. 6, pt. 1, p. 47, pl. 10, fig. 1.
Cassis globosa Dall, *1916*, U. S. Nat. Mus., Proc., vol. 51, no. 2162, p. 508 (in part). Not *Phalium globosum* DALL, *1890*, Wagner Free Inst. Sci., Trans., vol. 3, pt. 1, p. 161. Not *Cassis* (*Phalium*) *globosum* DALL, *1892*, Wagner Free Inst. Sci., Trans., vol. 3, pt. 2, p. 262, pl. 20, figs. 6, 11 (fig. 6 = *Phalium globosum* Dall, from the Ocala limestone; fig. 11 = *Phalium brevicostatum* (Conrad), from railroad cut near Indian Mound, 4½ miles east of Newton, Miss.).
Cassis sp. WOODRING, *1928*, Carnegie Inst. Washington, Pub. 385, p. 305.
Cassis sp. MANSFIELD, *1938*, Washington Acad. Sci., Jour., vol. 28, no. 3, p. 101, fig. 11.

Shell of medium size, broadly biconic, the periphery, however, less than one-third the distance from the apex to the anterior extremity. Sculpture on early whorls not well-preserved, but traces retained of three beaded spirals, the posterior directly in front of the appressed suture, the anterior directly behind the suture, and the third spiral closer to the anterior than to the posterior spiral; posterior of the three spirals continuing directly in front of the suture to the aperture, heavily beaded on the later turns; anterior spiral developed on the body into a series of strong peripheral nodes, of which

six can be seen in the rear view; the third spiral with similar but more numerous beads than that in front of the suture; a secondary intercalated on the later whorls between each pair of primaries; a second series of nodes developed on the body, a little behind the middle, fewer in number than in the first series and staggered in position; space between the two series of nodes broken up into squarish pits by the intersection of the axial rugae with the evenly spaced spiral fillets; a similar series of checkerboard axials and spirals in front of the anterior nodes; axial sculpture relatively stronger and less regular on the anterior half of the body; an overhang and two or three stronger and more distantly spaced spirals behind the basal groove. Channel behind the fasciole narrow, U-shaped, very deep. Fasciole short, high, bent almost at right angles to the axis of the aperture. Aperture of holotype badly damaged. Outer lip on the paratype nearly vertical, heavily varicose, with traces retained of the characteristic transverse ridges. A wide spread of heavy callus on the inner face, its outer margin free and overlapping the preceding varix at 240° from the outer lip; inner margin of pillar transversely ridged; character of surface of body callus not known. Anterior canal short and narrow; margins parallel and very close together at the anterior extremity.

Holotype (U. S. Nat. Mus. 498499) measures: Height, 48.5 mm; diameter (not the maximum), 33 mm, Paratype (U. S. Nat. Mus. 498500) measures 70 mm in height. Holotype from station 14083, Flint River near Bainbridge, Ga. Paratype from station 12723, upper bed on A. L. Parrish farm, 3½ miles southeast of Wausau, Washington County, Fla. Figured body whorl (U. S. Nat. Mus. 498672) from station 14281, 1½ miles north of Waynesboro, Miss.

Holotype from Flint River formation; paratype from Suwannee limestone; figured body whorl from lower part of Chickasawhay marl.

The holotype, which is smaller than some of the other specimens from Flint River, was collected by August F. Foerste, when he accompanied Raphael Pumpelly on a boat trip down the river. The exact date is not known, but he referred to the Bainbridge material in a paper published in 1893. The collections were made at a number of points in the vicinity of Bainbridge, but the exact locality is not known. Later collections including *Cassis flintensis* have been made along the Flint River from a point 7 miles above Bainbridge to Blue Springs, 4 miles below Bainbridge.

The specimen which Dall figured came from station 7096, Red Bluff on the west bank of Flint River, 7 miles above Bainbridge, Decatur County, Ga. Woodring (1928) referred to this species as probably representing "the earliest American species of *Cassis*." Earlier species determined as *Cassis*, such as the Claiborne *brevicostatum* Conrad and the Ocala *globosum*, together with *caelatura* from the Byram marl, should be referred to *Phalium*. *Cassis sulcifera* Sowerby, a Dominican Miocene species to which the Flint River individuals were first assigned is more angular than that from the Flint River, the spire is lower and broader and the sides of the whorls more oblique. The spiral sculpture is much more obscure on the West Indian form, and the irregular, anastamosing tendency of the axials is accentuated. However, there seems to be a wide range of individual variation in these sculpture characters.

Occurrence.—Flint River formation. GEORGIA: Station 7118, roadside near bridge over Jones Creek, 1¼ miles southwest of Oakfield, Worth County; stations 3388 and 7096, Red Bluff on the west bank of Flint River, 7 miles above Bainbridge; station 14083, Flint River near Bainbridge; station 7150*a*, east bank of Flint River, just below the wagon bridge at Bainbridge, from loose blocks of chert; station 3391?, Bluff below Plant System Wharf, Bainbridge; station 2573, Blue Spring, east side of Flint River, 4 miles below Bainbridge; station 3381, base of the bluff at Little Horseshoe Bend, on the Flint River, 4 miles south of Bainbridge and about one-fourth mile from the mouth of the stream flowing from Blue Spring; station 7079, Mascot Point, east side of Flint River, below mouth of Blue Spring Branch; station 7074, Hale's Landing, west bank of Flint River, 7 miles southwest of Bainbridge, Decatur County; station 10393, well at depth of 55 feet, 4¾ miles east of Thomasville, Thomas County.

Suwannee limestone. FLORIDA: Station 12723, upper bed on the A.L. Parrish farm, 3½ miles southeast of Wausau, Washington County.

Lower part of Chickasawhay marl. ALABAMA: Station 14205*a*?, one-fourth mile north of Perdue Hill, Clarke County. MISSISSIPPI: Station 14281, highway bridge over Taylor Mill Creek, 1½ miles north of Waynesboro.

Genus SCONSIA Gray
SCONSIA sp. cf. S. LINTEA (Conrad)

A *Sconsia* too imperfectly preserved to determine but retaining no characters by which it may be separated from *Sconsia lintea* (Conrad) described from the Byram marl at Vicksburg has been recovered from the lower part of the Chickasawhay marl at station 14204, the lowest bed at Taylor Mill Creek, 1½ miles north of Waynesboro, Wayne County, and from station 13239, Bucatunna Creek, NW ¼ sec. 17, T. 8 N,. R. 5 W., also in Wayne County. A nondescript internal mold, which may very well represent the same species, was found on Rocky Branch, 1 mile north-northeast of Denham, Wayne County. *Sconsia lintea* has also been determined from external molds from station 7211, 3 miles north of Castleberry, Conecuh River, Ala.

INCERTA SEDIS
Plate 27, figure 38

An external mold (U.S.N.M.498501) from the Suwannee limestone at station 12723, the upper bed on the A. L. Parrish farm, 3½ miles southeast from Wausaw, Washington County, Fla., reveals the outline and sculpture pattern of the anterior portion of the body of a species that is apparently new and of unusual interest. The species is with little doubt a cassid though not *Cassis*. It is probably allied to a rare form from the Vicksburg, which Conrad described in 1860 under the name of *Galeodia tricarinata*, but which is distinct from *Galeodia* in apertural characters. The lower middle and basal parts of the body of the Suwannee individual are girded with seven prominent spiral cords, with three to six secondary lirae intercalated between each pair of primaries. Both the primary and secondary spirals are more sharply elevated and more regular in size and disposition than those of Conrad's Vicksburg species. The curvature of the base of the body and the faint crenulation of the anterior peripheral primary are, however, similar in the Suwannee and the Vicksburg examples.

Genus FICUS ("Bolten") Roeding
FICUS MISSISSIPPIENSIS Conrad?
Plate 27, figures 36, 45

Ficus mississippiensis CONRAD, *1848*, Acad. Nat. Sci. Philadelphia, Jour., 2d ser., vol. 1, pt. 2, p. 117.

Pyrula mississippiensis SMITH, *1907*, Acad. Nat. Sci. Philadelphia, Proc., pp. 210, 214–216, 219, pl. 17, fig. 5.

Ficus sp. aff. *F. mississippiensis?*. MANSFIELD, *1938*, Washington Acad. Sci., Jour., p. 101.

Internal and external molds of a *Ficus* closely related to if not identical with *Ficus mississippiensis* Conrad described from the Byram marl at Vicksburg, Miss., are widely distributed in the upper Oligocene of the eastern Gulf. The spire of the figured mold seems a little lower than that of the usual Vicksburg individual, but there is an appreciable variation in the height of the spire in the specimens both from Vicksburg and from the localities farther east. The sculpture of the external molds is similar to that of Conrad's species. In the Alum Bluff and later representatives of the genus the spirals are relatively lower, less even, and less widely spaced, while the axials are less laminar, and the resulting sculpture pattern is decidedly cancellate. It is unfortunate that the diagnostic protoconch is not preserved, for the nucleus of *Ficus mississippiensis* includes a larger number of smooth whorls than the nuclei of the later species.

Figured mold (U. S. Nat. Mus. 498502) is 25 mm in diameter. From Suwannee limestone, at station 12723, A. L. Parrish farm, 3½ miles southeast of Wausau, Washington County, Fla.

Occurrence.—Suwannee limestone. FLORIDA: Station 12723, A. L. Parrish farm, 3½ miles southeast of Wausau, Washington County.

Lower part of Chickasawhay marl. ALABAMA: Stations 6735 and 14355, Murder Creek, at bridge east of Castleberry, Conecuh County; station 6749, McGowan's

Bridge, Conecuh River, 1 mile below the mouth of Sepulga River, Escambia County; station 7166, east bank of Tombigbee River, just south of Payne's Hammock, Clarke County. MISSISSIPPI: Station 13239, NW ¼, sec. 17, T. 8 N., R. 5 W., Bucatunna Creek, Wayne County.

Genus CLAVA Martyn

CLAVA sp.

Plate 27, figure 25

An apparently undescribed species is represented by two rather small and incomplete external molds from the lower part of the Chickasawhay marl at station 14519, about halfway up the hill, along the old road leading down to Limestone Creek, three miles north of Waynesboro, Wayne County, Miss. The shells were of moderate dimensions for the genus and rather slender. The sculpture is reticulate, the axials most evident at the intersection with the spirals, which they nodulate; the spirals flattened, strong, even, symmetrically disposed, three to each of the medial and later whorls of the spire. The axials are a little less closely spaced than the spirals, so that the rectangular pits enclosed are slightly wider than high. Toward the aperture, in the unfigured specimen, which is probably conspecific, the ribs tend to become varicose, and there are traces of an intercalated secondary between each pair of primaries.

Clava sp. is similar in general outline and sculpture pattern to *Clava parrishi* Mansfield, 1938, described from the Suwannee limestone on the A. L. Parrish farm, about 3½ miles southeast of Wausau, Washington County, Fla. The Chickasawhay species is less slender than *C. parrishi*; the axials are less closely spaced and less strongly nodose at the intersection with the spirals; and secondary spirals are not developed on the early and medial portions of the shell, as they are in the Suwannee species. A related form too imperfectly preserved for identification was collected from the Suwannee limestone, 10.2 miles northwest of Brooksville, Hernando County, Fla.

The height of the figured mold (U.S.N.M. 498503) is about 20 mm; the greatest diameter, 7 mm.

Subgenus OCHETOCLAVA Woodring

CLAVA (OCHETOCLAVA?) PERDUENSIS

Mansfield, n. sp.

Plate 27, figure 13

Shell rather small and slender, the tip and aperture not preserved. About seven closely appressed postnuclear whorls known, the whorls increasing very slowly in diameter, scarcely at all rounded, the body rather high and distorted by a strong varix. Axials low, rounded, feebly arcuate, extending from suture to suture, about 14 or 15 to each of the later whorls. Spirals straplike, emphasized by the fine, sharply incised striation on either side, very low and flat, but overriding the axials, approximately equal in width to the interspaces, four in number on the medial whorls of the spire, a fifth disclosed toward the body by the slight forward sag in the suture line. Characters of aperture not known.

Incomplete holotype (U. S. Nat. Mus. 498504) measures: Height, 20 mm; diameter, 7 mm. From lower part of Chickasawhay marl at station 14205*a*, gully, one-fourth mile north of Perdue Hill, Clarke County, Ala.

Clava (*Ochetoclava?*) *perduensis* is apparently related closely to *C. georgiana* (Lyell and Sowerby) and to the coexistant and possibly identical *C. platynema* (Dall). It is a much smaller shell than either of the other two, but the material is too imperfect to rule out the possibility of immaturity. A specimen of *C. georgiana* from Jacksonboro, the type locality, must have been between 65 and 70 mm high. No juvenile or adolescent specimens of *georgiana* or *platynema* are included in our collections, so an adequate comparison is not possible.

Clava (*Ochetoclava?*) *perduensis* is known from the type locality alone.

CLAVA (OCHETOCLAVA?) WATSONENSIS

Mansfield, n. sp.

Plate 27, figure 18

Species known only from incomplete external molds. Shell rather small, multigyrate, the exact number of whorls unknown; figured specimen including six to seven postnuclear volutions separated by channeled sutures. Whorls flattened, axials narrow,

rounded, probably 15 to 20 to each of the later whorls, persisting from suture to suture, fairly uniform in size excepting for an occasional varicose costal. Primary spirals straplike, disposed on the whorl with approximate symmetry, nodose at the intersection with the axials, which they overrun. A fine secondary threadlet intercalated between the posterior pair of primaries and that in front; between the two anterior primaries and between the anterior primary and the suture; posterior pair of primaries a little more closely spaced than the other two and without intercalaries. Suture drooping forward a little near the aperture disclosing an additional primary. Characters of aperture and anterior canal not preserved.

Incomplete holotype (U. S. Nat. Mus. 498505) measures: Height, 13 mm; diameter, 5 mm. From lower part of Chickasawhay marl at station 6758, south bank of Yellow River at Watson [Watkins] and Henderson Bridge, Covington County, Ala.

A knowledge of the characters of the aperture and the anterior canal are essential for the generic determination. The sculpture pattern and the dimensions recall *Clava* (*Ochetoclava*), but the subgenus has not previously been recorded in pre-Miocene faunas. Some of the species described as *Bittium* and *Cerithiopsis* from the Tampa and Flint River limestones have a sculpture pattern similar to that of *watsonensis*, but the shells are much smaller. A much smaller species of rather similar sculpture occurs in the upper Chickasawhay at station 14287, on Patton Creek, 1½ miles east of Waynesboro, Wayne County, Miss. A generic determination cannot be made.

Occurrence.—Lower part of Chickasawhay marl. Stations 6758 and 14292, the south bank of the Yellow River at Watson [Watkins] and Henderson Bridge, Covington County, Ala.

Genus PETALOCONCHUS H. C. Lea
PETALOCONCHUS VARIANS d'Orbigny

Poorly preserved specimens similar to those from the Tampa limestone that were referred questionably to *Petaloconchus varians* d'Orbigny were collected from the upper Chickasawhay. The locality is station 14287, at the waterfall on Patton Creek, one-fourth mile above Highway 45, 1½ miles east of Waynesboro, Wayne County, Miss.

Genus TURRITELLA Lamarck
TURRITELLA sp. cf. T. GATUNENSIS Conrad
Plate 27, figures 56, 57

Turritella gatunensis Conrad. MANSFIELD, *1938*, Washington Acad. Sci., Jour., vol. 28, no. 3, p. 102, figs. 1–3, 6.

In examining specimens referred to *T. gatunensis* from G formations of the Canal Zone two varieties are observed. In one variety which occurs in the Vamos-a-Vamos bed and in lower faunal zone of the Gatun formation, a depression develops on the early whorls whereas in the second variety occurring in the middle faunal zone of the Gatun formation at the Gatun dam (station 8365 and other stations) the earliest whorls are medially carinated, the anterior spiral coming in later.

The form at the A. L. Parrish farm more closely resembles those from the Vamos-a-Vamos and in the lower faunal zone of the Gatun formation.

Two external molds showing the early parts of a *Turritella* have been collected at station 13396, above the mouth of Limestone Creek, near the middle of sec. 25, T. 9 N., R. 7 W., Wayne County, Mississippi, by Roy T. Hazzard. These probably belong to *Turritella gatunensis* Conrad. Specimens from station 1/52, Gainestown Ferry, Clarke County, Alabama, referred by Cooke to the Chickasawhay marl member of the Byram marl are the same as those at the A. L. Parrish farm. MANSFIELD, 1938.

The figured holotype of *Turritella gatunensis* Conrad (1857) is a broken specimen and does not show the character of the early whorls. The type itself is apparently lost, and there is some doubt as to which variety is represented by Conrad's figure.

The Mississippi species should probably be referred to *Turritella gatunensis, s. l.* rather than to *T. gatunensis, s. s.*

The figured molds (U.S.N.M. 498506 and U.S.N.M. 498507) measure about 25 mm in height, but the figure of the former is ×1½, that of the latter ×1½.

The mold that includes the apical whorls in part is from station 14323, the highest fossiliferous bed in the ravine 200 yards south-southwest, of Jones' old plantation house, about 1 mile northwest of Glendon Station, Clarke County, Ala. The other figured mold is from station 14205*a*. Both specimens are from the lower part of the

Chickasawhay marl. The species is also recorded from several other localities.

Occurrence.—Lower part of Chickasawhay marl. ALABAMA: Station 14293, Weaver's Chute, east side of Conecuh River, sec. 18, T. 2 N., R. 13 E., Escambia County; station 14205*a*, overlying limestone in gully about one-fourth mile north of Perdue Hill, Monroe County; station 10052, Gainestown Ferry; station 14323, highest fossiliferous bed in ravine 200 yards south-southwest of Jones' old plantation house, 1 mile northwest of Glendon Station, Clarke County; station 14291, 1.3 miles north of Millry, Washington County. MISSISSIPPI: Station 13396, hillside above mouth of Limestone Creek, near middle of sec. 25, T. 9 N., R. 7 W., Wayne County; station 14204?, lower blue marl bed, Taylor Mill Creek, just east of highway bridge on Highway 45, 1½ miles north of Waynesboro (juveniles, identification uncertain); station 14281, "*Chione* limestone" above blue marl bed, Taylor Mill Creek, 1½ miles north of Waynesboro; station 13240, sec. 18, T. 8 N., R. 5 W., Rocky Branch, probably from the lower bed.

TURRITELLA MONROENSIS
Mansfield, n. sp.
Plate 27, figure 59

Shell large, slender, the apical angle between 15° and 20°, and the number of whorls probably between 15 and 20. Nuclear whorls and earliest postnuclear whorls lost. On earliest of the retained whorls a single strong basal cord, and in front of the posterior suture a sharp thread; and between the posterior thread and the anterior cord a concave medial area; a second basal cord emerging behind the anterior suture, and a second thread in front of the posterior suture, becoming in late adolescence equal in prominence to the original cord and thread with which they are paired; a fine sharp threadlet developed later on the strongly concave interarea but closer to the posterior pair of spirals than to the anterior pair; basal spirals apparently overrun with fine secondary threadlets, though the condition of preservation of the material obscures this character. Suture lines distinct and later whorls undercut. Characters of aperture lost, the body whorl doubtfully retained on a single individual; spiral sculpture on body possibly becoming obsolete, but the incrementals greatly strengthened; sinus as indicated by the growth lines deep, its axis coincident with the concave area between the anterior and posterior pairs of spirals.

Incomplete holotype (U. S. Nat. Mus. 498478) measures: Height, 68 mm; diameter, 17 mm. From lower part of Chickasawhay marl at station 14205*a*, overlying limestone in gully about one-fourth mile north of Perdue Hill, Monroe County, Ala.

Turritella monroensis recalls *T. halensis* Dall (1916) from the Flint River formation at Hale's Landing, Flint River, Ga. It is a more slender shell, however, than the Flint River species and differs in the detail of the sculpture pattern. In *T. halensis*, the anterior of the two basal cords is less prominent than that behind it; there is a single posterior primary, but several secondaries are intercalated between the primary and the posterior suture and on the shallow concave medial area between the anterior and posterior primaries. However, by slight modifications in the relative prominence of the posterior and the anterior spirals, and the introduction of additional secondaries, *T. monroensis* approaches very closely to *T. halensis*, and it is possible that the forms are only subspecifically distinct. Both *T. halensis* and *T. monroensis* may be in the line of descent from *T. martinensis* Dall of the Ocala limestone in Florida, and may belong to the group which includes *T. mississippiensis* Conrad from the Byram marl at Vicksburg. In sculpture pattern, the Vicksburg species more closely resembles *T. halensis* and lacks the characteristic paired anterior spirals of *T. monroensis*.

The species is known only from external molds.

Occurrence.—Lower part of Chickasawhay marl. ALABAMA: Station 14205*a*, overlying limestone, gully about one-fourth mile north of Perdue Hill, Monroe County; station 14323, highest fossiliferous bed in ravine 200 yards south-southwest of Jones' old plantation house, about 1 mile northwest of Glendon Station; station 14322?, uppermost fossiliferous bed on north side of Salt Creek on road from Jackson to Rockville, sec. 34, T. 6 N., R. 2 E., Clarke County (specimens adult and fairly numerous, but too imper-

fect for certain determination). MISSISSIPPI: Station 14285*a*, "*Chione* limestone," Limestone Creek Church, 4 miles north of Waynesboro; station 14282, "*Chione* limestone," blocks of limestone along roadside near Limestone Creek, 3 miles north of Waynesboro (probably blocks from top of hill); station 14281, "*Chione* limestone" at Taylor Mill Creek, 1½ miles north of Waynesboro, Wayne County.

TURRITELLA sp. aff. T. BOWENAE
Mansfield
Plate 27, figures 52, 58

A species known only from external molds from a few localities in southern Alabama resembles *Turritella bowenae* Mansfield (1937) in the general sculpture pattern but differs in the outline of the whorls. The whorls of *T. bowenae* are trapezoidal, and the regular outline of the spire is conspicuously interrupted only by the heavy basal cords. In the Alabama species the medial part of the whorl is broadly depressed, but it is less strongly concave than in *T. monroensis* Mansfield. In both *T. bowenae* and the unnamed species, the entire surface of the adult whorls seems to be overrun with a fine secondary threading, *Turritella monroensis* displays something of the sort on the posterior cords, but apparently the threading is much less prevalent than in *Turritella bowenae*.

Figured specimens (adolescent, U. S. Nat. Mus. 498479; fragment of adult whorls, U. S. Nat. Mus. 498480) measure: Height of adolescent, 39 mm; diameter of figured adult whorls of another individual, 19.5 mm. From lower part of Chickasawhay marl (probably synchronous with the Suwannee limestone of Florida from which *Turritella bowenae* was derived) at station 14292, south bank of Yellow River, site of Watson [Watkins] and Henderson bridge, sec. 13 or 14, T. 1 N., R. 15 E., Covington County, Ala.

The larger specimen figured has developed two rather strong basal cords, the lower slightly more prominent than the one behind it; two or three lirations on the feebly depressed medial area; a single posterior thread slightly more prominent than those in front of it, and stronger, also, than the one to three lirae on the posterior slope behind. In the specimens from the other two localities, station 7165, 200 yards north of Salt Creek, 4½ miles south of Jackson, and station 3640, Payne's Hammock, 10 miles south of Jackson, Clarke County, Ala., the posterior of the two basal cords is a little stronger than that in front of it, but the other details of the sculpture pattern are similar to those of the specimens figured.

TURRITELLA sp. cf. T. PAGODAEFORMIS
Heilprin

Numerous poorly preserved external molds of *Turritella* were recovered from the upper part of the Chickasawhay marl at station 14287, the waterfall on Patton Creek, 1½ miles east of Waynesboro, Wayne County, Miss. Among them is a fragment of a large and rather stout individual which in the characters retained resembles *Turritella pagodaeformis* Heilprin from the Tampa limestone of Florida. Most of the molds, however, represent a smaller, more slender undetermined species with a strongly concave median area.

TURRITELLA PERDUENSIS
Mansfield, n. sp.
Plate 27, figures 50, 54, 55

Shell of only moderate dimensions, slender, the apical angle between 15° and 20°. Whorls many, the number indeterminate, separated by distinct sutures. Nuclear and earliest postnuclear whorls lost. Earliest remaining whorls sculptured with two subequal beaded spirals, the one anterior, the other posterior, and between them a deep equatorial area, threaded with three or four finely beaded lirae; later sculpture modified by the introduction of a second posterior spiral behind the original, which within a few whorls equals the first in prominence and like it is rather strongly beaded; at a later growth stage a second anterior spiral emerges from behind the suture line, and additional secondaries are introduced. Characters of aperture not preserved.

A juvenile syntype (U. S. Nat. Mus. 498481) is 14 mm high. A syntype of 3 adult whorls (U.S.N.M. 498483) measures 20 mm in height and 10 mm in diameter.

There is one other syntype a fragment of about 4 whorls, probably not fully adult (U.S.N.M. 498482). The types are from the lower part of the Chickasawhay marl at station 10334, a quarter of a mile northeast of Perdue Hill, Monroe County, Ala.

The shell most closely comparable in outline and sculpture pattern is *Turritella ceibana* Cooke (1928) from the Oligocene of Mexico, but in the Mexican species the constriction at the suture is much more pronounced than in the adult *T. perduensis*; the anterior spiral is relatively stronger, and the posterior spiral is less definitely paired, although there is a beaded secondary behind the primary. The equatorial secondaries are less numerous and not so fine.

Turritella perduensis and *T. ceibana* probably belong to a group distinct from that represented by the larger, coarser shells of *T. halensis* and the closely allied *monroensis*, *T. bowenae* and the later *T. tampae* of Heilprin.

Turritella perduensis like the other species from the upper Oligocene limestones is known only from molds of the exterior.

Occurrence.—Lower part of Chickasawhay marl: ALABAMA: Station 10334, a quarter mile northeast of Perdue Hill; station 14205*a*, overlying limestone in gully about a quarter mile north of Perdue Hill, Monroe County.

TURRITELLA sp.
Plate 27, figure 53

A new species of *Turritella* is indicated by a broken external mold which includes a part of five whorls. The shell was of moderate dimensions and rather slender. Both the anterior and the posterior extremities have been lost. The sculpture pattern, however, differs from that of any described form. There are three prominently elevated spirals to the whorl, the anterior of the three a double cord. The medial and posterior are approximately equal in elevation, the posterior possibly slightly more prominent than the medial, the three spirals symmetrically disposed on the whorl and separated from the preceding and succeeding whorls by a deeply concave interspace. The suture line is exceedingly obscure.

The figured mold (U.S.N.M. 498484) is about 20 mm high and was collected at station 10053, 4 miles north of Waynesboro, Wayne County, Miss.

A closely related and possibly identical species may be represented by an external mold from station 13381, 1½ miles north of Millry, Washington County, Ala. In the Alabama species, the anterior of the three spirals, instead of being similar to the two in front of it excepting for the medial groove is split into two distinct and much finer spirals. In *Turritella ceibana* Cooke (1928) from Rio Buena Vista at La Ceiba road crossing Veracruz, Mexico, there are a pair of anterior and a pair of posterior spirals, and between them a concave, depressed area threaded by a beaded secondary. The primaries are strongly beaded, too, while those of the Mississippi shell were apparently simple.

Genus CALYPTRAEA Lamarck
CALYPTRAEA sp.

Internal and external molds of *Calyptraea* have been collected at a number of localities both in the lower and in the upper part of the Chickasawhay marl. The largest, an external mold 45 to 50 mm in diameter, from station 14364, near the top of the Chickasawhay River section, retains remnants of an irregular radial sculpture. Other molds referable to indeterminate *Calyptraea* were collected from the lower part of the Chickasawhay marl, at station 10334, one-fourth mile northeast of Perdue Hill, Monroe County; station 7165, 200 yards north of Salt Creek on Jackson-Rockville road, 4½ miles south of Jackson, Clarke County, Ala. Station 13386, hill above quarry at mouth of Limestone Creek, 3 miles northwest of Waynesboro; stations 14360 and 14362, the glauconitic beds near the base of the Chickasawhay River section one-fourth mile below the bridge on the Waynesboro-Laurel road, 2½ miles west of Waynesboro, Wayne County, Miss.

Genus POLINICES Montfort
POLINICES? sp.
Plate 27, figure 43

A small naticoid (U. S. Nat. Mus. 498671) 6.8 mm high and 6.2 mm in greatest diameter was collected from the lower Chickasaw-

hay at station 14204, the lowest bed at the bridge over Taylor Mill Creek on Highway 45, 1½ miles north of Waynesboro, Wayne County, Miss. Three or four rapidly increasing whorls are included. The outline of the spire is broad and fairly smooth, and the body is evenly rounded. The margin of the whorl in front of the suture is slightly crushed locally, much as in some specimens of *Polinices vicksburgensis* (Conrad), but this is doubtless an individual character incident to the thinness of the shell directly in front of the suture. The aperture is obliquely lobate and obtusely angulated posteriorly. The outer lip is smoothly flaring and rather sharp at the margin. The parietal callus is heavy at the commissure and broadly and feebly constricted between the commissure and the umbilicus. The characters of the umbilicus are obscured by the slight breakage of the shell. Apparently there is a feeble funicular rib similar to that of *P. vicksburgensis*, but it is not outlined by a well-defined groove like that of *P. byramensis* Cooke. The margin of the umbilicus is rounded much as in *P. vicksburgensis*, and in front of the umbilicus the margin of the aperture is slightly reverted and thickened. The calloused parietal wall indicates maturity, but adult *P. vicksburgensis* are double the size of the Chickasawhay specimen, which is probably new.

Other forms incompletely preserved but apparently similar in general character occur at station 13239 in the NW ¼ sec. 17, T. 8 N., R. 5 W., on Bucatunna Creek, Wayne County, Miss. A fragment from station 14289, sec. 10, T. 8 N., R. 7 W., on the Chickasawhay, Wayne County, Miss., displays the retractive grooves radiating from the posterior suture which characterize *Natica* (*Naticarius*).

Genus AMPULLINA Bowdich
Subgenus AMPULLINOPSIS Conrad
AMPULLINA (AMPULLINOPSIS) AMPHORA (Heilprin)
Plate 27, figure 39

Natica amphora HEILPRIN, *1887*, Wagner Free Inst. Sci., Trans., vol. 1, p. 112, pl. 16, fig. 50.
Ampullina (*Ampullinopsis*) *amphora* DALL, *1892*, Wagner Free Inst. Sci., Trans., vol. 3, pt. 2, p. 375.
Ampullina amphora DALL, *1915*, U. S. Nat. Mus., Bull. 90, p. 108, pl. 11, fig. 5. Occurrence in Chipola marl excepted.
Ampullina (*Ampullinopsis*) *amphora* MANSFIELD, *1937*, Florida Geol. Survey, Bull. 15, p. 175.

In its somewhat crushed and incomplete state the figured specimen measures almost 90 mm in height and 99 mm in greatest diameter. The diameter, however, is probably exaggerated by the crushing. The specimen is an internal mold to which thin fragments of the original shell still adhere. The sutures are deeply channeled, and strong retractive growth lines are developed on the final half turn. The figured example (U.S.N.M. 498485), was associated with large Ostrea in the upper Chickasawhay at station 14289, near the top of the Chickasawhay River section, one-fourth mile downstream from the highway bridge on the Waynesboro-Laurel road, 2½ miles west of Waynesboro, Wayne County, Miss. A body whorl, possibly referable to *Ampullina amphora*, was recovered, also, at station 14287, at the waterfall on Patton Creek, one-fourth mile above Highway 45, and 1½ miles east of Waynesboro, Wayne County, Miss.

The occurrence of *Ampullinopsis amphora* below the Tampa limestone and its time equivalents has not been established.

Genus PACHYCROMMIUM Woodring
PACHYCROMMIUM sp.
Plate 27, figure 44

Molds from the lower part of the Chickasawhay marl in western Alabama are similar, except for their much smaller size, to molds from the Flint River and Suwannee limestones of Georgia and Florida referred by Dall (1916) to *Amauropsis ocalana* Dall, and by Mansfield (1937) to "*Amauropsis*" aff. *A. burnsii meridionalis* Pilsbry. As Mansfield indicated, *Amauropsis ocalana* is a *nomen dubium*, for the specimens from the Ocala limestone were not adequately isolated, described, or figured. In any case, the Ocala species is distinct from that from Flint River. In *Amauropsis burnsii meridionalis* described by Pilsbry from the middle Miocene of the Dominican Republic, the whorls are more inflated than those of either the Flint River and Suwannee forms or of *Pachycrommium* sp, and the apical angle is higher than in any of the Oligocene molds. The Chickasawhay specimens from

Perdue Hill are little more than half as high as the mold figured by Mansfield from Flint River, the inflation of the body is slightly higher, and the apical angle slightly lower than that of the Georgia form. It is apparently closer, however, to the Flint River and Suwannee species than it is to *Pachycrommium*? sp., the conspicuously tabulated form from the Chickasawhay marl of Wayne County, Miss.

The height of the incomplete figured specimen (U.S.N.M. 498486) is 27 mm, the diameter, 17 mm. *Pachycrommium* sp. is known from the single locality, station 14205*a*, the overlying limestone in a gully about one-fourth mile north of Perdue Hill, Monroe County, Ala.

PACHYCROMMIUM? sp.
Plate 27, figure 8

An internal mold (U.S.N.M. 498487) of doubtful affinities differs, possibly generically, from the specimens referred to *Pachycrommium* sp. Both of the figured ampullinids include in their incomplete form between three and four volutions, but the body in *Pachycrommium*? is shorter relatively, and the whorls of the spire are strongly tabulated and separated by channeled sutures, so that the profile of the decollated spire is like a stile.

The height of the incomplete mold is 36 mm; the diameter, 26 mm.

Pachycrommium? sp. is fairly common in the lower part of the Chickasawhay marl at the single locality at which it occurs, station 14519, an old road on the east side of the new road, south of Limestone Creek, about halfway up the hill, Wayne County, Miss.

Genus SINUM "Bolten" Roeding
SINUM sp. cf. S. MISSISSIPPIENSE (Conrad)
Plate 27, figure 46

A species closely related to *Sinum mississippiense* described by Conrad (1848) from Vicksburg, Miss., is rather widely distributed in the lower part of the Chickasawhay marl in western Alabama and eastern Mississippi. The curvature of the body of the Chickasawhay form seems a little higher, and the profile of the posterior part of the shell less even than that of the Vicksburg species, The character of the sculpture is the same in the two forms, and the slight differences in outline are probably of less than specific value. Certain conclusions, however, cannot be drawn, for the Chickasawhay specimens are poorly preserved. The best of them has been figured. The small nucleus of three to four smooth, polished volutions is succeeded by two postnuclear volutions. The body is obliquely compressed, more so than in *S. mississippiense*, and the surface crowded with irregular flattened spirals more or less wrinkled by the growth lines. The margin of the aperture is broken. The inner lip was reinforced and reverted slightly but not sufficiently to close completely the narrow umbilical chink.

Figured specimen (U. S. Nat. Mus. 498488) measures: Height, 14 ± mm; diameters, 13.5 ± mm. From station 14204, lower bed of blue marl on Taylor Mill Creek, just below the highway bridge on State Highway 45, 1½ miles north of Waynesboro, Wayne County, Miss.

A similar mold apparently referable to the same species as those from the Chickasawhay was recovered in late collections of the Suwannee limestone in northern Florida.

Occurrence.—Suwannee limestone. FLORIDA: Station 12723, upper bed on the H. L. Parrish place, 3½ miles southeast of Wausau, Washington County, Fla.

Lower part of Chickasawhay marl. ALABAMA: Station 10334, one-fourth mile northeast of Perdue Hill, Monroe County; station 7166, bed no. 3, east bank of the Tombigbee River, just south of Payne's Hammock, Clarke County. MISSISSIPPI: Station 13396, hillside above mouth of Limestone Creek, near middle of sec. 25, T. 9 N., R. 7 W.; station 14283, top of hill on old road leading down to Limestone Creek, 3 miles north of Waynesboro; station 14204, lower bed, Taylor Mill Creek, just below the bridge on Highway 45, 1½ miles north of Waynesboro, Wayne County.

Genus EUNATICINA Fisher
EUNATICINA sp. cf. E. CONRADII Dall

A broken shell (U.S.N.M. 498489) comparable to *Eunaticina conradii* Dall from

the Vicksburg of Mississippi was collected from the lower part of the Chickasawhay marl at station 14204, the lowest bed at the bridge over Taylor Mill Creek on Highway 45, 1½ miles north of Waynesboro, Wayne County, Miss. The outline of the Chickasawhay shell is similar to that of *E. conradii*, but the sculpture seems a little coarser. The generic characters of the group are so marked that there is a strong resemblance between the Chickasawhay form, *Eunaticina caractica* Dall from the Chipola formation, and *Eunaticina regia* (Guppy) from the Bowden beds.

Genus TURBO Linnaeus
TURBO sp.
Plate 27, figure 37

The existence of *Turbo* in the Chickasawhay seas is strongly indicated if not established by internal molds and molds of the apical and peripheral surfaces. The nuclear characters are not known, nor those of the aperture and operculum. The shell must have included at least four postnuclear whorls, which were full and increased rapidly in diameter. A shoulder is obscurely suggested on the later whorls, but the body was apparently strongly and evenly rounded at the periphery. The early whorls of the spire are threaded with six subequal, apparently smooth spirals, the two peripheral spirals becoming slightly stronger relatively on the final whorl of the spire, and obscurely beaded. On the body, the beading becomes stronger on the principal spirals, and a single secondary is introduced between each pair of primaries on the medial part of the whorl. The suture is distinct and feebly excavated.

Diameter of figured mold (U. S. Nat. Mus. 498490), probably not the maximum, 25 mm. From lower part of Chickasawhay marl at station 14282, 3 miles north of Waynesboro, Wayne County, Miss. Blocks of limestone along side road, probably fallen from a higher level.

Turbo sp. suggests in its outline and sculpture pattern the higher, less evenly rounded and more ornate *Turbo* (*Taeniaturbo*) *dominicensis* Gabb from the middle Miocene of the Dominican Republic and the later Miocene of the Bowden beds of Jamaica. The characteristic features of the section *Taeniaturbo* Woodring are the wide, slightly raised band of callus with which the inner lip is fused in the umbilical area and the sculpture pattern of the operculum. The section has not been recorded in strata earlier than the middle Miocene nor from Recent waters other than those of eastern mid-America and the Gulf of Mexico.

Occurrence.—Lower part of Chickasawhay marl: MISSISSIPPI: Station 14282, 3 miles north of Waynesboro; station 14519, the old road on the east side of the new road, south of Limestone Creek, about halfway up the hill, Wayne County.

REFERENCES

BLANPIED, B. W., ET AL., *1934*, Stratigraphy and paleontological notes on the Eocene (Jackson group), Oligocene and lower Miocene of Clarke and Wayne Counties, Mississippi: *Shreveport Geol. Soc., Eleventh Ann. Field Trip.* Includes comments on the microfauna of the Chickasawhay members, by C. I. Alexander; "Preliminary paleontologic analysis of the upper and lower Chickasawhay members of the Catahoula formation," by Henry V. Howe; and "Bryozoa of the upper and lower Chickasawhay members of the Catahoula formation of Wayne County, Mississippi," by James McGuirt.

CONRAD, T. A., *1848*, Observations on the Eocene formation, and description of one hundred and five new fossils of that period, from the vicinity of Vicksburg, Miss.: *Acad. Nat. Sci. Philadelphia, Jour.*, 2d ser., vol. 1.

——, *1857*, *Pacific Railroad Repts.*, vol. 6, pt. 2, p. 72, pl. 5, fig. 20.

COOKE, C. W., *1919*, Tertiary mollusks from the Leeward Islands and Cuba: *Carnegie Inst. Washington, Pub.* 391, p. 140, pl. 11.

——, *1926*, Geology of Alabama; The Cenozoic formations: *Alabama Geol. Survey, Special Rept.* 14, pp. 251–297. The beds later called Chickasawhay marl are included in the Byram marl, pp. 287–294.

——, *1928*, New Vicksburg (Oligocene) mollusks from Mexico: *U. S. Nat. Mus., Proc.*, vol. 73, art. 10.

——, *1935*, Notes on the Vicksburg group: *Am. Asso. Petroleum Geologists, Bull.*, vol. 19, pp. 1162–1172. Describes the "Chickasawhay marl member of the Byram marl" and correlates it tentatively with the Flint River formation of Georgia and Alabama, the Antigua formation of the Leeward Islands, and the Meson formation of Mexico. It is placed at the top of the Vicksburg group.

——, *1939*, Boundary between Oligocene and Miocene: *Am. Asso. Petroleum Geologists, Bull.*, vol. 23, pp. 1560–1561. Treats the Chickasawhay marl as an independent formation at the top of the Vicksburg group.

DALL, W. H., *1890–1903*. Contributions to the Tertiary fauna of Florida, with especial reference to the Miocene silex beds of Tampa and the Pliocene beds of the Caloosahatchie River: *Wagner Free Inst. Sci., Trans.*, vol. 3.

——, *1915*, A monograph of the molluscan fauna of the *Orthaulax pugnax* zone of the Oligocene of Tampa, Florida: *U. S. Nat. Mus., Bull.* 90.

——, *1916*, A contribution to the invertebrate fauna of the Oligocene beds of Flint River, Georgia: *U. S. Nat. Mus., Proc.*, vol. 51, pp. 487–524.

HOWE, H. V., *1937*, Large oysters from the Gulf Coast Tertiary: *Jour. Paleontology*, vol. 11, pp. 355–366. Describes *Ostrea blanpiedi* from "upper Chickasawhay sediments" in Mississippi and Alabama.

MANSFIELD, W. C., *1937*, Mollusks of the Tampa and Suwannee limestones of Florida: *Florida Geol. Survey, Bull.* 15.

——, *1938*, Oligocene faunas from the lower and upper beds on the A. L. Parrish farm, Washington County, Florida: *Washington Acad. Sci., Jour.*, vol. 28, no. 3, pp. 93–107.

WOODRING, W. P., *1928*, Miocene mollusks from Bowden, Jamaica, pt. 2: *Carnegie Inst. Washington Pub.* 385.

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EXPLANATION OF PLATE 27

FIGS. *1, 2, 9*—*Latirus taylorensis* Mansfield, n. sp. Syntypes, U. S. Nat. Mus. 498474, ×1½. (p. 208)
3—*Tropisurcula* cf. *T. caseyi* (Aldrich). U. S. Nat. Mus. 498466, ×2. (p. 205)
4—*Fusiturricula waynesboroensis* Mansfield, n. sp. Holotype, U. S. Nat. Mus. 498461, ×1½. (p. 204)
5—*Pleurofusia* sp. U. S. Nat. Mus. 498459, ×1. (p. 204)
6—*Pleurofusia* cf. *P. vicksburgensis* Casey. U. S. Nat. Mus. 498458, ×1. (p. 203)
7—*Fusiturricula* cf. *F. servata* (Conrad). U. S. Nat. Mus. 498462, ×1. (p. 205)
8—*Pachycrommium?* sp. U. S. Nat. Mus. 498487, ×1. (p. 223)
10—*Murex?* sp. U. S. Nat. Mus. 498496, ×1½. (p. 213)
11—*"Alectrion?"* sp. B. U. S. Nat. Mus. 498494, ×1½. (p. 212)
12—*Tritaria waynensis* Mansfield, n. sp. Holotype, U. S. Nat. Mus. 498477, ×2. (p. 211)
13—*Clava* (*Ochetoclava?*) *perduensis* Mansfield, n. sp. U. S. Nat. Mus. 498504, ×2. (p. 217)
14—*Scobinella taylorensis* Mansfield, n. sp. Paratype, U. S. Nat. Mus. 498468, ×1½. (p. 206)
15—*Syntomodrillia?* cf. *S.? tantula* Conrad. U. S. Nat. Mus. 498465, ×2½. (p. 206)
16—*Olivella* cf. *O. affluens* Casey. U. S. Nat. Mus. 498471, ×1½. (p. 207)
17—*Fasciolaria* cf. *F. petrosa* Dall. U. S. Nat. Mus. 498473, ½. (p. 209)
18—*Clava* (*Ochetoclava?*) *watsonensis* Mansfield, n. sp. Holotype, U. S. Nat. Mus. 498505, ×1½. (p. 217)
19—*Cancellaria* (*Bonellitia*) *waynensis* Mansfield, n. sp. Holotype, U. S. Nat. Mus. 498469, ×2. (p. 207)
20—*Tritiaria* sp. U. S. Nat. Mus. 498476, ×2. (p. 209)
21—*Pleuroliria? waynensis* Mansfield, n. sp. Holotype, U. S. Nat. Mus. 498460, ×2. (p. 204)
22—*Terebra* (*Strioterebrum*) *tantula* Conrad? U. S. Nat. Mus. 498456, ×1½. (p. 203)
23—*Terebra* (*Strioterebrum*) *waynesboroensis* Mansfield, n. sp. Holotype, U. S. Nat. Mus. 498455, ×1¼. (p. 203)
24—*Cylichna* sp. U. S. Nat. Mus. 498454, ×5. (p. 202)
25—*Clava* sp. U. S. Nat. Mus. 498503, ×1. (p. 217)
26—*Fusiturricula?* sp. U. S. Nat. Mus. 498463, ×1½. (p. 205)
27—*Melongena* sp. U. S. Nat. Mus. 498475, ×1½. (p. 209)
28—*"Alectrion"* sp. A. U. S. Nat. Mus. 498493, ×1½. (p. 212)
29—*Cancellaria* (*Trigonostoma*) sp. U. S. Nat. Mus. 498470, ×1. (p. 207)
30—*Hemipleurotoma?* sp. U. S. Nat. Mus. 498464, ×1½. (p. 205)
31—*Scobinella taylorensis* Mansfield, n. sp. Holotype, U. S. Nat. Mus. 498467, ×1½. (p. 206)
32—*Metula taylorensis* Mansfield, n. sp. Holotype, U. S. Nat. Mus. 498495, ×2½. (p. 212)
33—*Cadulus waynensis* Mansfield, n. sp. Holotype, U. S. Nat. Mus. 498491, ×5. (p. 202)
34—*Scalina waynensis* Mansfield, n. sp. Holotype, U. S. Nat. Mus. 498498, ×2. (p. 214)
35—*Kuphus incrassatus* Gabb. U. S. Nat. Mus. 496240, ×½ (after Mansfield). (p. 201)
36—*Ficus mississippiensis* Conrad? U. S. Nat. Mus. 498502, ×1. (p. 216)
37—*Turbo* sp. U. S. Nat. Mus. 498490, ×¾. (p. 224)
38—*Incerta sedis*. U. S. Nat. Mus. 498501. (p. 216)
39—*Ampullina* (*Ampullinopsis*) *amphora* (Heilprin). U. S. Nat. Mus. 498485, ×¼. (p. 222)
40—*Tritiaria* cf. *T. vicksburgensis* (Aldrich). U. S. Nat. Mus. 498492, ×2. (p. 211)
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43—*Polinices?* sp. U. S. Nat. Mus. 498671, ×2. (p. 221)
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45—*Ficus mississippiensis* Conrad? U. S. Nat. Mus. 498502, ×1. (p. 216)
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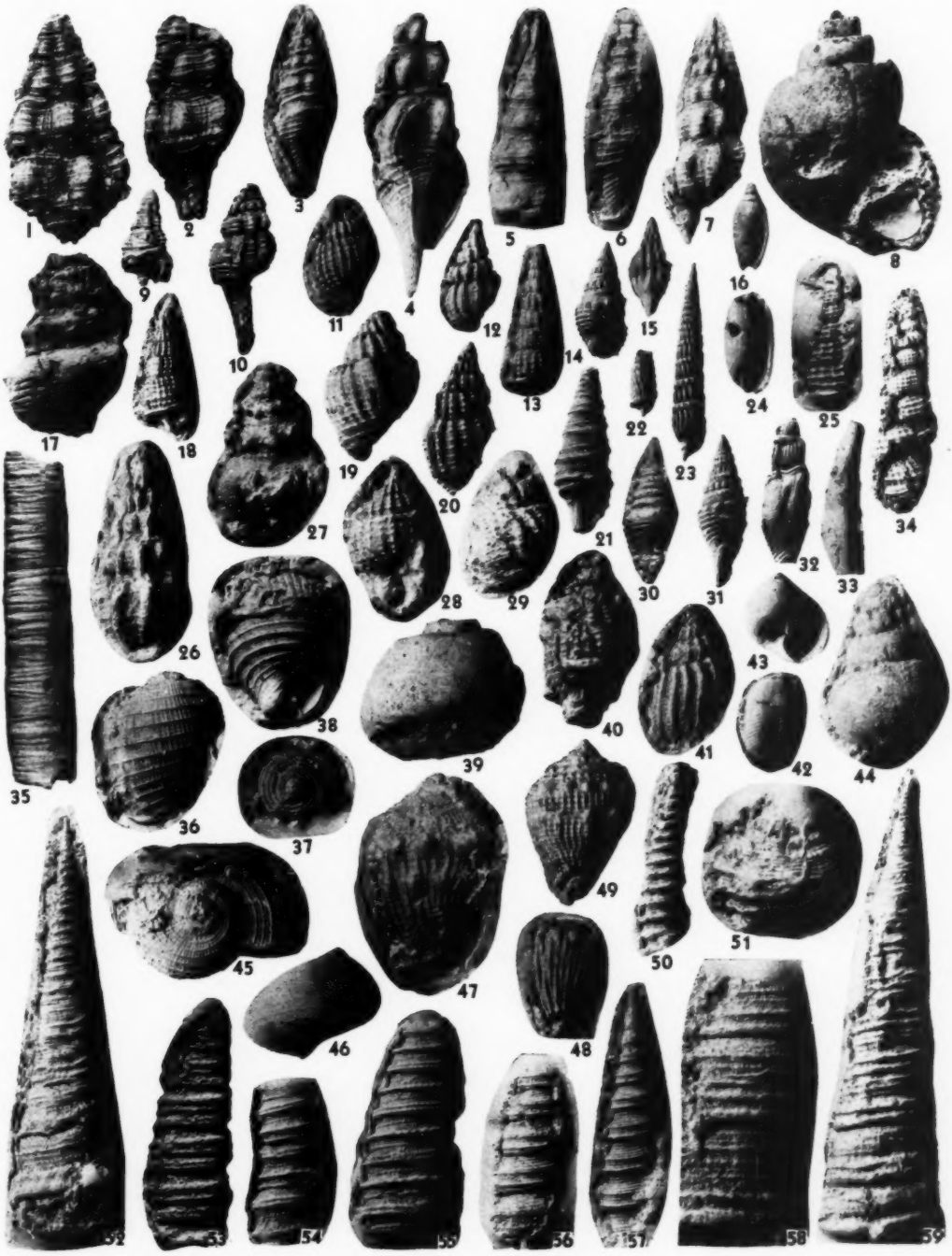
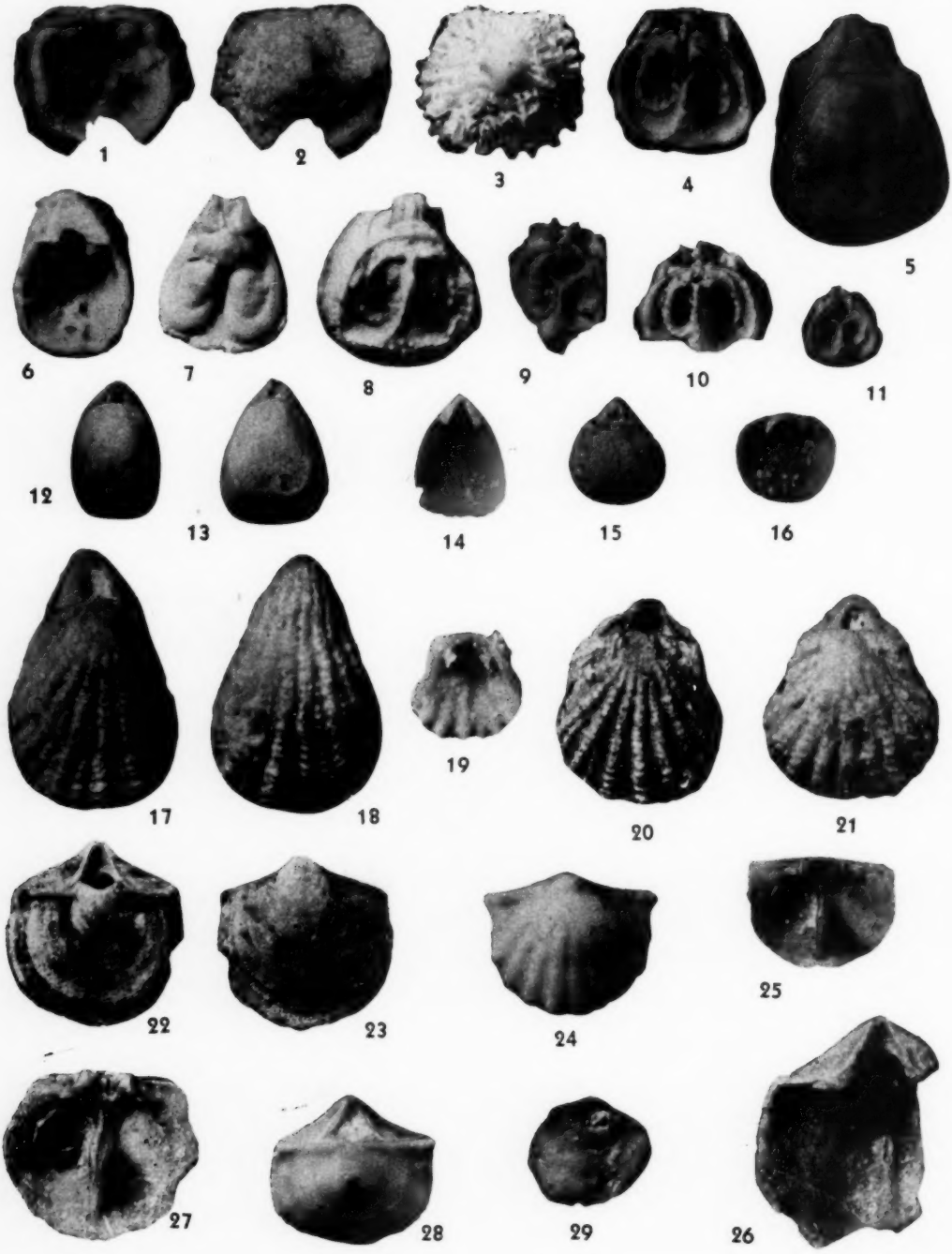


Mansfield, Chickasawhay Mollusks



Toulmin, Eocene (Salt Mountain) Brachiopoda

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EOCENE BRACHIOPODS FROM THE SALT MOUNTAIN LIMESTONE OF ALABAMA

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ABSTRACT—Brachiopods belonging to seven genera are figured. Two new species are described. All were obtained from the Salt Mountain limestone of lower Eocene age in Clarke County, Alabama.

THE Salt Mountain limestone is exposed in a small area about six miles south of Jackson in Clarke County, Alabama. It was brought to the surface on the upthrown side of the Jackson fault and is adjacent to similarly dipping limestones of Vicksburg (Oligocene) age that occur on the downthrown side of the fault. The formations of the Vicksburg group appear to dip beneath the Salt Mountain limestone. This led the geologists who first worked in the area to believe that the Salt Mountain limestone was younger than the Vicksburg limestones. The Salt Mountain limestone is now known to be separated from the Vicksburg group by the plane of the Jackson fault, and its contact with overlying sands and clays of Wilcox (Eocene) age has been observed. Mr. B. W. Blanpied was the first to determine the lower Wilcox age of the formation (Crider, and others, 1932).

The Salt Mountain limestone contains a varied fauna, but the specimens are poorly preserved, and only four species have been

EXPLANATION OF PLATE 28

All figures but *1* and *2* are ×12. All specimens illustrated are from the Salt Mountain limestone of Wilcox Eocene age, Clarke County, Alabama. P. U. indicates Princeton University collection. A. M. indicates Alabama Museum of Natural History collection.

FIGS. *1–3*—*Crania?* sp. *1*, *2*, Interior and exterior views of dorsal valve, ×8¼, from salt Mountain, 48 feet below top of Mountain; P. U. 50742. *3*, Exterior view of dorsal valve of a small specimen from "spring" half a mile north of Salt Mountain; P. U. 50743. (p. 228)

4–11—*Thecidellina cooperi* Toulmin, n. sp. *4*, Interior view of dorsal valve of holotype, from Salt Mountain, 30 feet below top of Mountain; P. U. 50744. *5*, Dorsal view of complete specimen, paratype, from Salt Mountain, 26 feet below top; P. U. 50745. *6*, Ventral valve, paratype, from Salt Mountain, 10 feet below top; P. U. 50746. *7*, Ventral valve, paratype, showing mold of interior of dorsal valve, from top of Salt Mountain; A. M. paratype 1. *8*, Dorsal valve of specimen, paratype, from Salt Mountain, 26 feet below top; A. M. paratype 2. *9–11*, Dorsal valves, paratypes, showing character of preservation of the median septum, from Salt Mountain, 30 feet below top; A. M. paratypes 3–5. (p. 228)

12–14—*Cryptopora?* sp. *12*, Dorsal view of a typical specimen, from road cut 300 feet southeast of Salt Mountain; P. U. 50747. *13*, Dorsal view of a specimen with unusually wide anterior end, from top of hill 3000 feet south of Salt Mountain; P. U. 50748. *14*, interior view of ventral valve, from Salt Mountain, 26 feet below top; P. U. 50749. (p. 229)

15, *16*—Rhynchonellid? sp. *15*, Dorsal view of complete specimen, from gully in the NW ¼ NE ¼ sec. 16, T. 5N., R. 2E., 2¼ miles south of Salt Mountain; P. U. 50758. *16*, Interior view of dorsal valve of a specimen from Salt Mountain, 30 feet below top; P. U. 50759. (p. 230)

17–21—*Terebratulina* sp. *17*, *18*, Dorsal and ventral views of specimen from Salt Mountain, 26 feet below top; P. U. 50750. *19*, Interior view of dorsal valve of specimen from Salt Mountain, 48 feet below top; P. U. 50751. *20*, Dorsal view of specimen with a long hinge line, from top of hill 3000 feet south of Salt Mountain; P. U. 50752. *21*, Dorsal view of specimen from Salt Mountain, 48 feet below top; A.M. (p. 230)

22–28—*Argyrotheca saltmountainensis* Toulmin, n. sp. *22*, *23*, Dorsal and ventral views of holotype; P. U. 50753. *24*, Ventral view of a strongly ribbed specimen, paratype; P. U. 50754. *25*, Interior view of dorsal valve, paratype; P. U. 50755. *26*, Interior view of ventral valve,paratype; P. U. 50756. *27*, Interior view of dorsal valve; A. M. paratype 6. *28*, Dorsal view of specimen without ribs; A. M. paratype 7. All from Richmond Branch, half a mile north of Salt Mountain, in NW ¼ NW ¼ sec. 34, T. 6 N., R. 2 E. (p. 231)

29—*Platidia*, sp. Dorsal view of complete specimen from top of hill 3000 feet south of Salt Mountain; P. U. 50757. (p. 233)

described, all of them by Vaughan (1900, 1936). The described species include two corals, *Actinacis alabamensis* (Vaughan) and *Stylophora ponderosa* Vaughan, and two orbitoidal foraminifera, *Discocyclina cookei* Vaughan and *Discocyclina blanpiedi* Vaughan. The limestone also contains fragments of echinoderms, a few fragmentary remains of mollusks, abundant remains of Bryozoa, several species of ostracods, and a large number of species of Foraminifera. The presence of minute shells of brachiopods, especially *Argyrotheca* and *Thecidellina*, is characteristic of the Salt Mountain limestone at the type locality. The faunal assemblage is very similar to that of the Vincentown limesand of New Jersey, from which several species of brachiopods have been described. Jennings (1936), as a result of a study of the microfauna from the basal Rancocas group of New Jersey, correlated the Hornerstown and Vincentown formations with the lower Wilcox of Alabama. Previously (1928) Cooke and Stephenson had correlated the Rancocas with the Aquia formation of Maryland (lower Eocene) on the basis of the larger fossils.

The writer is indebted to Dr. G. A. Cooper of the United States National Museum for suggestions and criticism and for his kindness in making available for comparison specimens in the collection of the Museum. Dr. H. B. Stenzel of the Bureau of Economic Geology at Austin, Texas, very kindly placed the collections of the Bureau at the writer's disposal for study.

Holotypes and paratypes of new species are in the Princeton University collection. Other paratypes and duplicate specimens are in the United States National Museum and Alabama Museum of Natural History.

SYSTEMATIC DESCRIPTIONS

Order NEOTREMATA Beecher
Superfamily CRANIACEA Waagen
Family CRANIIDAE King
Genus CRANIA Retzius, 1781

CRANIA? sp.
Plate 28, figures 1–3

Dorsal valve small, about as wide as long, conical, flattened posteriorly and anteriorly from the apex to the margin. Apex prominent, subcentral. Outline subcircular, posterior margin straight, lateral and front margins gently rounded. Test with radiating costellae becoming increasingly spinose away from the apex. Interior of dorsal valve with border around the margin of the valve. Inner limit of the border marked by rounded raised ridge surrounding the interior. Posterior adductor pedestals slightly raised, rounded, near the posterior border within the inner angles of the posterior raised ridge. Anterior adductor pedestals near center of the valve, consisting of two short oblique elevations diverging posteriorly. A similarly shaped elongate prominence in the median line is directed anteriorly from its juncture with the anterior adductor pedestals. Impressions of pallial sinuses in the anterior portion of the valve not seen.

Dimensions of illustrated specimen, figs. 1, 2: Length, 3.00 mm; width, 3.42 mm.

Locality.—Salt Mountain limestone, 48 feet below top of Salt Mountain, in the SW ¼ SW ¼ sec. 34, T. 6 N., R. 2 E.

Depository.—Princeton Univ., nos. 50742, 50743.

Remarks.—Dorsal valves of a species of spiny *Crania* are common in the Salt Mountain limestone. A single specimen was observed that showed clearly the muscular impressions. The dorsal valve of this specimen is illustrated. The dorsal valves of *Crania?* sp. are often irregular in shape as a result of the ventral valve being attached to an uneven surface.

Crania has a long geologic range extending from early Paleozoic time to Recent. Tertiary species of the genus are known from Europe and New Zealand. No Tertiary species has hitherto been described from North America.

Order PROTREMATA Beecher
Superfamily STROPHOMENACEA Schuchert
Family THECIDEIDAE Gray
Genus THECIDELLINA Thomson, 1915

THECIDELLINA COOPERI Toulmin, n. sp.
Plate 28, figures 4–11

Shell small, thick, rostrate, subtrigonal in outline. Hinge line straight, shorter than the greatest width of the shell. Ventral valve attached by the ventral surface of the beak. Surface of valves marked by concentric growth lines only. Beak produced, callous

on the ventral side irregular because of variation in the position and proportions of the attached surface. Cardinal area of the beak large, triangular, flat.

Ventral valve very convex, deep, thickened. Hinge teeth stout, cylindrical protuberances projecting forward from the cardinal margin on each side of a rectangular open space in the cardinal area of the beak. Beak hollow. Other structures on the interior of the ventral valve unknown. Septum not seen.

Dorsal valve subcircular, with straight hinge line. Greatest width of dorsal valve near the middle or just forward of the middle. Dorsal surface nearly flat to gently convex, becoming more strongly convex in the middle of the valve toward the umbo. Socket ridges uniting medianly and projecting posteriorly to form a prominent rectangular cardinal process. Dental sockets consisting of a pair of small, round, deep depressions dorsal to the cardinal process and on each side of it. Interior of dorsal valve surrounded by a broad, raised, outwardly sloping granulated margin, and divided medianly by a strong high septum. Septum extending posteriorly from the granulated anterior margin, becoming higher posteriorly, and reaching nearly to the bridge that crosses the posterior portion of the valve. Anteriorly the edges of the septum join with the inner edges of the granulated margin in a smooth curve enclosing the oval brachial furrows. Granulated margin on each side of the valve continuing posteriorly to the cardinal margin, stopping just outside the dental sockets near the extemities of the hinge line. The raised inner edge of the margin continuing as a high thin ridge in a smooth curve across the posterior portion of the valve, forming a bridge at the forward end of the cardinal process. The keel-like bridge is penetrated by a pair of small round holes ventral to the cardinal process. The depression on each side of the valve between the septum and the margin is occupied by an oval-shaped area deepened in the middle and surrounded by a serrate edge roughly parallel to the inner edge of the granulated margin and septum.

The high posterior end of the septum is not attached directly to the inner surface of the dorsal valve but is separated from it by a hollow space or cavity in the posterior portion of the valve. The shell matter covering this cavity, including the posterior end of the septum and the bridge, is destroyed in many of the specimens. Three depressions are then present in the interior of the dorsal valve, one on each side of the short remaining part of the septum and the other situated medianly in the posterior half of the valve.

Dimensions of dorsal valve of holotype: Length, 1.83 mm; width, 2.02 mm.

Type locality.—Salt Mountain limestone, 6 miles south of Jackson, Alabama, in the SW ¼ SW ¼ sec. 34, T. 6 N., R. 2 E., 30 feet below top of Salt Mountain.

Holotype.—Princeton Univ., no. 50744.

Paratypes.—Princeton Univ., no. 50745, 50746; Alabama Mus. Nat. History, paratypes 1–5.

Remarks.—*Thecidellina cooperi* closely resembles *T. barretti* Davidson but differs from it in having the septum thinner and higher at the posterior end. *Thecidellina cooperi* is common throughout the Salt Mountain limestone. It is named in honor of Dr. G. A. Cooper of the United States National Museum.

Thecidellina is known from the Miocene of New Zealand and Italy, from the Pliocene of the West Indies, and is living in the present oceans. *T. cooperi* extends the range of the genus to the lower Eocene. The only other North American species that has been described is *T. barretti* Davidson, Pliocene and Recent, from the West Indies.

Order TELOTREMATA Beecher
Superfamily RHYNCHONELLACEA Schuchert
Family DIMERELLIDAE Buchman
Genus CRYPTOPORA Jeffreys, 1869
CRYPTOPORA? sp.
Plate 28, figures 12–14

Shell minute, thin and delicate, suboval in outline, tapering posteriorly. Greatest width of shell generally forward of the midline. Anterior margin bluntly rounded. Valves biconvex. Dorsal valve less strongly convex than the ventral. Test smooth, with faint growth lines on the dorsal valve. Anterior commissure rectimarginate. Hinge line short, curved. Beak short, straight. Deltidial plates rudimentary. Interior of

ventral valve with low pedicle collar, not supported by a median septum. Hinge teeth small, supported by divergent dental plates.

Dimensions of illustrated specimen, fig. 12: Length, 1.77 mm; width, 1.17 mm.

Locality.—Salt Mountain limestone, on Jackson-Rockville road 300 feet southeast of Salt Mountain, Clarke County, Alabama.

Depository.—Illustrated specimens at Princeton Univ., nos. 50747–50749.

Remarks.—There is some question about assigning this form to *Cryptopora* inasmuch as the internal structures of the dorsal valve have not been seen. It is not known whether or not a median septum is present. There was no indication of a median septum in two individuals which were sectioned. Short divergent dental plates were revealed in a section of a complete specimen but were not observed in any of the loose ventral valves.

This small shell bears a close resemblance to the exterior of *Cryptopora gnomon* Jeffreys, the type species of the genus, but is more strongly biconvex, and the anterior commissure is straight, not sulcate. The beak is perfectly straight, not incurved as in figures of *C. gnomon*. It is similar to *Cryptopora brazieri* Davidson in dorsal view, and the beak of the latter is straight, but *C. brazieri* is much flatter than the Salt Mountain form.

Cryptopora? sp. is fairly common in the Salt Mountain limestone.

No Tertiary species of *Cryptopora* have been described from North America. *C. gnomon* and *C. brazieri* are Recent species living in the North Atlantic and South Pacific, respectively.

Family Rhynchonellidae Gray
Rhynchonellid? sp.
Plate 28, figures 15, 16

Shell minute, thin, subcircular in outline, about as wide as long. Valves biconvex, becoming somewhat flattened toward the margin. Dorsal valve uniformly convex, slightly less convex than the ventral valve. Ventral valve strongly convex posteriorly beneath the beak. Anterior commissure rectimarginate. Cardinal area trigonal. Hinge line straight. Beak short, straight, with posterior tip erect. Deltidial opening subtrigonal. Foramen apparently hypothyrid, almost submesothyrid. Test smooth or with indication of two or more very faint striae on the dorsal valve diverging anteriorly. Very small shallow circular depression at the cardinal margin of the dorsal valve. Interior of dorsal valve without median septum.

Dimensions of illustrated specimen, fig. 15: Length, 1.38 mm; width, 1.26 mm.

Locality.—Salt Mountain limestone, from gully near the base of a high hill in the NW ¼ NE ¼ sec. 16., T. 5 N, R. 2 E., Clarke County, Alabama.

Depository.—Princeton University, nos. 50758, 50759.

Superfamily Terebratulacea Waagen
Family Terebratulidae Gray
Subfamily Cancellothyrinae Thomson
Genus Terebratulina d'Orbigny, 1847
Terebratulina sp.
Plate 28, figures 17–21

Shell small, biconvex, subtrigonal in outline. Cardinal margin submegathyrid. Test with nodulous costae equally developed on both valves. Interior of the valves crenulated along the margin. Beak short. Foramen large, triangular.

Dimensions of illustrated specimen, figs. 17, 18: Length, 3.18 mm; width, 2.22 mm.

Locality.—Salt Mountain limestone, 26 feet below top of Salt Mountain, in the SW ¼ SW ¼ sec. 34, T. 6 N., R. 2 E., Clarke County, Alabama.

Depository.—Illustrated specimens in Princeton Univ., nos. 50750–50752; others in the Alabama Mus. Nat. History.

Remarks.—No complete full-grown specimens of this genus were obtained. Several complete specimens possessing features characteristic of the youthful stage of *Terebratulina* and fragments of the shells of mature individuals were found. These fragments and the more mature complete specimens indicate that the genus is *Terebratulina* and not *Eucalathis*. The young shell resembles the latter genus in such features as the triangular cardinal area, straight hinge line, and the subtrigonal outline of the shell. The fragments of mature individuals show a change in the shape of the shell, a shortening of the hinge line, an increase in number of ribs, and a great decrease in their relative size. The Salt

Mountain form bears a closer resemblance to the figures of young specimens of *Terebratulina retusa* Linné, the type species of the genus, than to figures of *Eucalathis murrayi* Davidson. The foramen is triangular and not rounded as in *Eucalathis* and the ribs are narrower. Davidson (1886–1888) makes the following statement concerning the young form of *T. retusa:*

> The shell varies somewhat in shape and especially, according to age, in the number of its ribs. These modifications have been often described by myself and others, and most recently, in 1884, by M. E. Deslongchamps (*Études, critiques sur des brachiopodes nouveaux ou peu connu:* Caen, 1884). In the youngest condition the shell tapers posteriorly, and is widest anteriorly; the hinge line is then almost straight, the auricular expansions comparatively larger, the foramen triangular or elongated oval . . . As the shell grows larger, the auricular expansions become smaller, the hinge line oblique, or obtusely angular, the ribs more numerous and finer, the lines of growth less prominent, and the greatest breadth at about half the shell's length. Similar important modifications take place also in the interior of the valves.

Family TEREBRATELLIDAE King
Subfamily MEGATHYRINAE Dall
Genus ARGYROTHECA Dall, 1900

ARGYROTHECA SALTMOUNTAINENSIS
Toulmin, n. sp.
Plate 28, figures 22–28

Shell minute, outline varying widely in relative proportions, generally semicircular, less commonly transversely elongate. Cardinal margin megathyrid, hinge straight. Angle between the cardinal line and the lateral margins approaching a right angle. Lateral profile nearly plano-convex. Anterior commissure rectimarginate, lateral commissures curving upward at the posterior extremities. Shell surface smooth to feebly multiplicate opposite; strongly punctate. Plicae absent or feeble, varying in number up to 10 or more. External surface of some specimens concentrically rugose near the margin. Median line of both valves in a few specimens occupied by a shallow sulcus. Beak short, subtruncate. Cardinal area varying greatly in height in different individuals. Foramen large, trigonal. Deltidial plates small, disjunct. Median septum in the ventral valve thin and keel-like, extending forward nearly to the middle of the valve. Small pit at the forward end of the septum near the middle of the ventral valve. In some specimens the septum continues as a low broadly rounded ridge nearly to the anterior margin. Median septum in dorsal valve extending nearly to the anterior margin of the valve, high, triangular in profile. Apex of septum near the middle of the valve. Apex fits into small pit near the middle of the ventral valve.

Dimensions of holotype: Length, 2.22 mm; width, 2.28 mm.

Type locality.—Salt Mountain limestone 6 miles south of Jackson, Alabama. In Richmond Branch, 400 feet southeast of the "spring," in the NW ¼ NW ¼ sec. 34, T. 6 N., R. 2 E.

Holotype.—Princeton Univ., no. 50753.

Paratypes.—Princeton Univ., nos. 50754–50756; Alabama Mus. Nat. History, paratypes 6, 7, 8.

Remarks.—This species is common throughout the Salt Mountain limestone. There is considerable individual variation in the length of the hinge line, elongation of the shell, length of the beak, height of the cardinal area, and prominence of the plications, but there is intergradation among individuals in all of these characters, and they all probably belong to one species.

Specimens obtained from the somewhat argillaceous limestone on Richmond Branch were characterized by having a lower cardinal area and a posteriorly projecting beak. The specimen selected as the type is characteristic of those from this locality. Shells of specimens from other facies of the limestone are thicker dorsoventrally, the cardinal area is higher, the beak is directed ventrally rather than posteriorly, and the outline is commonly transversely elongate. These differences in shape may be due to the differences in shape of the objects to which the shells were attached. Specimens attached by a short pedicle to wide flat surfaces may develop a broader hinge line, a higher cardinal area, and a more truncated beak than those specimens attached in such a way that the beak and cardinal area can grow unhindered.

Argyrotheca saltmountainensis is somewhat similar to *A. beecheri* (Clark) of the Vincentown limesand (Eocene), but differs from it in that the plications, when present, are more numerous and much less promi-

nent than in *A. beecheri*. The anterior margin is commonly smoothly rounded, never as strongly serrate as that of *A. beecheri*.

A. saltmountainensis resembles *A. powersi* Gardner in outline, and in having a feebly plicate shell. It differs from *A. powersi* in size, being smaller, and in internal structure. The median septum of the ventral valve does not extend to the front margin as in *A. powersi*, and the internal structure of the dorsal valve is different. It differs from *A. dalli* Aldrich in having a straight and longer hinge line, and in internal structure. It differs from *A. schucherti* Dall in being less distinctly plicate.

The Recent *A. bermudana* Dall is similar to *A. saltmountainensis* in some respects. *A. bermudana* has a smooth shell without plications, a feature characteristic of one variant of *A. saltmountainensis*. In *A. bermudana* the front edge of the median septum in the dorsal valve is serrate, but in *A. saltmountainensis* the front edge of the septum is smooth. The median septum in the ventral valve of *A. bermudana* extends nearly to the distal margin, but in *A. saltmountainensis* it extends forward no farther than the middle of the valve.

The Salt Mountain species resembles *A. berryi* Olsson from the upper Eocene of Peru in external form. This is a smooth species sometimes having very faint costae. The figure of the syntype shows a median furrow in the ventral valve, a feature not characteristic of the Alabama species. The internal structures of *A. berryi* were not described.

A. saltmountainensis is closely related to an undescribed *Argyrotheca* represented by several well-preserved ribbed specimens in the collection of the Bureau of Economic Geology at Austin, Texas. These were collected by H. B. Stenzel from the Hatchetigbee formation (upper Wilcox) at Hatchetigbee Bluff, Washington County, Alabama, the type locality of *A. dalli* Aldrich. These specimens are distinctly different from the original figure of *A. dalli* and may belong to a different species. They bear a much closer resemblance to some specimens of *A. saltmountainensis* than to the figure of *A. dalli* Aldrich. The undescribed species from Hatchetigbee Bluff is semicircular in outline rather than subcircular as in *A. dalli* and has the greatest width along the hinge line. The internal structure of the dorsal valve differs from that of *A. dalli*. The ventral valve of *A. dalli* was not described. The Hatchetigbee form has about sixteen more or less distinct ribs and is very similar to the Salt Mountain specimen figured on plate 28, figure 24, except that it lacks the sharp cardinal angle. The internal structures of both valves are quite similar to those of *A. saltmountainensis*. The chief differences between the two forms are in their external features. The lateral commissure generally curves upward slightly in the Salt Mountain species as it approaches the cardinal angle, but in the Hatchetigbee species it is not deflected upward at the posterior extremity. The ribbing on the Hatchetigbee species is more uniform and distinct than on *A. saltmountainensis*. Specimens of the latter species from the type locality are commonly smooth, less commonly ribbed. The cardinal area is uniformly higher in the Hatchetigbee form than in the type specimen of *A. saltmountainensis*, and the ventral valve is correspondingly more convex in the former. The beak of the Hatchetigbee form does not project posteriorly as far as it does in the type specimen of *A. saltmountainensis*, and the specimens are about twice the size of the Salt Mountain type specimen. *A. saltmountainensis* may be ancestral to the Hatchetigbee species.

Several species of *Argyrotheca* have been described from the Tertiary of the Americas. These include *A. powersi* Gardner of Midway, Eocene, age from Butler Dome, Freestone County, Texas; *A. dalli* Aldrich from the upper Wilcox, Eocene, of Alabama; *A. beecheri* (Clark) and *A. plicatilis* (Clark) from the Vincentown limesand (lower Eocene) of New Jersey; *A. gardnerae* Cooke, 1935 (= *A. dalli* Cooke, 1919) from the upper Eocene of Saint Bartholomew; *A. berryi* Olsson, *A. chica* Berry, and *A. peruviana* Berry from the Eocene of Peru; *A. wegemanni* Cole from the Oligocene of Mexico; *A. clevei* (Davidson) from the Miocene of Saint Bartholomew; and *A. schucherti* Dall from the Miocene of Florida.

There are six known species of *Argyrotheca* living in the Atlantic in the vicinity of the West Indies.

Subfamily PLATIDIINAE Thomson, 1927
Genus PLATIDIA Costa, 1852
PLATIDIA? sp.
Plate 28, figure 29

Shell minute, subcircular in outline, hinge line straight. Ventral valve convex. Dorsal valve flat to irregular. Test smooth. Foramen amphithyrid. Foraminal notch in dorsal valve large, semicircular.

Dimensions of illustrated specimen: Width, 1.56 mm.

Locality.—Salt Mountain limestone, from top of hill in the SW cor. SW ¼ NW ¼ sec. 3, T. 5 N., R. 2 E.

Depository.—Illustrated specimen at Princeton Univ., no. 50757.

Remarks.—The specimen illustrated and several smaller, immature, specimens were obtained from the formation.

At least two species of Platidia have been described from the Tertiary of North America. They are *Platidia cretacea* Weller from the Vincentown limesand (lower Eocene) of New Jersey, and *Platidia marylandica* Clark from the Eocene of Maryland.

REFERENCES

CRIDER, A. F., HAZZARD, R. T., BLANPIED, B. W., and SPOONER, W. C., *1932, Guidebook of the Ninth Anual Field Trip of the Shreveport Geological Society*, p. 9.

DAVIDSON, T., *1886–1888*, A monograph of Recent Brachiopoda: *Linnean Soc. New South Wales, Trans.* ser. 2, vol. 4, Zool., p. 19.

JENNINGS, P. H., *1936*, A microfauna from the Monmouth and basal Rancocas groups of New Jersey: *Bull. Am. Paleontology*, vol. 23, no. 78, pp. 5, 9–11.

VAUGHAN, T. W., *1900*, The Eocene and lower Oligocene coral faunas of the United States with descriptions of a few doubtfully Cretaceous species: *U. S. Geol. Survey, Mon.* 39, pp. 132, 133, 194, pl. 13, fig. 16; pl. 14, figs. 1–1b; pl. 23, figs. 1–3; pl. 24.

VAUGHAN, T. W., *1936*, New species of orbitoidal Foraminifera of the genus *Discocyclina* from the lower Eocene of Alabama; *Jour. Paleontology*, vol. 10, no. 4, pp. 253–259, pls. 41–43.

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ORDOVICIAN MOHAWKIAN OSTRACODA: LOWER TRENTON DECORAH FAUNA

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ABSTRACT—The Decorah formation, composed principally of shales in the northern part of the outcrop in Iowa, Minnesota, and Western Wisconsin, has an ostracode fauna of about 80 species (28 new), 70 of which have been found in recently collected faunules; there are representatives of 39 genera, many of which have been based on Decorah species. A revised classification of the families Primitiidae and Beyrichiidae is presented. The new genera *Saccelatia*, *Winchellatia*, *Maratia*, *Parenthatia*, and *Opikatia* are defined. The new genus *Bolbiprimitia* is proposed for the Silurian *Halliella fissurella* Ulrich and Bassler. Dimorphism is represented in 12 of the genera, evidenced by marginal and intramarginal structures present in some forms and lacking in otherwise similar specimens. The two members of the formation—the Guttenberg and the Ion—have some distinctive species, but most of the Decorah forms are represented in both members. Faunas from the northern and southern parts of the belt of outcrop differ distinctly. The Decorah ostracode fauna is closely similar to that in the lower Trenton of Ontario; no other faunas of comparable size and age have been described in North America. The faunas of the Uhaku and Kukruse formations of the Baltic region are probably of similar age, but have no identical species and few that are similar to those in the Decorah. The interior North American and northern European faunas are of different faunal provinces; the Decorah fauna must be indigenous or of southern origin; many Upper Ordovician ostracodes of the interior of North America are quite similar to the Decorah species, and they would seem to be descendants.

THE DECORAH formation of Iowa and Minnesota comprises shales and limestones succeeding the Spechts Ferry shale member of the Platteville formation and underlying the "*Clitambonites*" or Vellamo zone of the Prosser formation; it is the oldest formation of the Trenton (Galena) group of the Mississippi Valley. Ostracoda are abundant in the shaly northern facies of the formation, and a considerable number of forms have been described previously (Ulrich, 1894; Kay, 1934). The paper lists the faunules collected from the formation and presents descriptions of new species and of those whose earlier descriptions can be revised. Dimorphic structures are represented in many of the forms; their character and significance is discussed. As a result of the study, the relations of the genera as expressed in their classification has been revised. The comparison of the Decorah ostracode fauna with those in other Ordovician formations emphasizes the fundamentally indigenous nature of the fauna.

The preparation of the study has been aided by the comments of H. N. Coryell and R. S. Bassler. The synonymy of many of the species is summarized by Bassler and Kellett (1934); the accessibility of this bibliographic index permits the omission of many references that otherwise might be required. O. H. Schindewulf and Paul Dienst placed the described Ostracoda in the museum of the Prussian Geological Survey at my disposal; J. H. Bonnema and A. Öpik furnished other specimens from the Baltic provinces.

STRATIGRAPHIC SUMMARY

The stratigraphy of the Decorah formation in northeastern Iowa has already been summarized (Kay, 1929), but subsequent studies have modified a number of conclusions expressed in the original paper (Kay, 1935). As now defined, the Decorah formation comprises two members, the Guttenberg and the Ion, the originally included Spechts Ferry member being the uppermost member of the Platteville formation. The ledges containing phosphatic and pyritic pebbles and pyritized fossils, formerly placed at the top of the Spechts Ferry member, are now considered to form the base of the Decorah formation. The *Rhinidictya* zone of Minnesota, which has been classified as Spechts Ferry, is now believed to be

equivalent to a part of the Guttenberg member; not only do the Ostracoda of the zone seem like those in the Guttenberg, but the pebble zone and metabentonite at the base of the zone at St. Paul (Sardeson, 1928) are probably the same as the pebble zone and a thin overlying metabentonite in the basal Guttenberg at McGregor, Iowa.

Thus, the Guttenberg member is believed to be represented in the *Rhinidictya* and *Ctenodonta* zones of Minnesota, and the Ion in the "*Phylloporina*" or *Chasmatopora*, and Fucoid zones. The beds have been correlated with the Rockland and lower Hull formations of the lower Trenton of Ontario (Kay, 1934).

STRATIGRAPHIC DISTRIBUTION

The stratigraphic and geographic distribution of the species of Ostracoda is shown in the accompanying table. These six localities have been selected because they yielded specimens of each of the species identified and produced a number of fossiliferous samples. Faunules were collected from many horizons in each section and have been assembled into larger zones. Not all the species listed from a single zone came from a single faunule. The sampling was not ideal; Guttenberg faunules are listed only from northern Iowa; and the number of fossiliferous Ion samples was considerably greater than of the Guttenberg.

Certain generalizations concerning stratigraphic and geographic ranges seem warranted. *Winchellatia lansingensis* and *W. longispina* are abundant in the Guttenberg samples and absent from those from the Ion; and *Macronotella multipunctata*, and *Schmidetella brevis*, are much more characteristic of Guttenberg than Ion faunules. *Bollia subaequata* is extremely abundant in the Ion in Iowa, about 20 per cent of all collected specimens being in this species it is absent in the Guttenberg and is also rare in the Ion in Minnesota. *Laccoprimitia fillmorensis*, *Dilobella typa* and *Conchoprimitia symmetrica* are frequent Ion species in both states, though most common in the north. *Bassleratia typa* is common only in the lower Ion and is locally abundant in Iowa. *Bollia subaequata* and *Bassleratia typa* are among the most abundant forms in the lower Hull beds in Ontario (Kay, 1934).

LOCALITIES

1. Guttenberg faunules, Church, Iowa; about 150 specimens.
2. Faunules from lower half of Guttenberg member, sec. 13, Glenwood Township, Winneshiek County, Iowa; about 250 specimens.
3. Faunules from upper half of Guttenberg member, sec. 13, Glenwood Township, Winneshiek County, Iowa; about 500 specimens.
4. Reported in Geology of Minnesota, vol. 3, pt. 2, 1894.
5. Faunules from Ion member, 50 to 60 feet above top of McGregor limestone of Platteville formation, 6 miles south of Cannon Falls, Minnesota, about 350 specimens.
6. Faunules from Ion member, 48 to 55 feet above top of McGregor limestone of Platteville formation, west of Ellsworth, Minnesota, about 250 specimens.
7. Reported in Geology of Minnesota, vol. 3, pt. 2, 1894.
8. Faunules from lower 3 feet, Ion member, Ion, Allamakee County, Iowa; about 250 specimens.
9. Faunules from upper part of Ion member, Ion, Allamakee County, Iowa, about 350 specimens.
10. Faunules from Ion member, Church, Iowa, about 500 specimens.
11. Faunules from upper 7 feet of Ion member, sec. 6, Glenwood Township, Winneshiek County, Iowa, about 600 specimens.
12. Faunules from lower third of Ion member, sec. 13, Glenwood Township, Winneshiek County, Iowa, about 250 specimens.
13. Faunules from middle third of Ion member, sec. 13, Glenwood Township, Winneshiek County, Iowa, about 300 specimens.
14. Faunules from upper third of Ion member, sec. 13, Glenwood Township, Winneshiek County, Iowa, about 200 specimens.

COMPARABLE FAUNAS IN OTHER REGIONS

There are few described faunas of Ostracoda of lower Trenton age, and of those distant from the Upper Mississippi Valley, only the fauna of the lower Hull in central Ontario (Kay, 1934) is distinctly like that of the Decorah. Three other formations in North America that seem of lower Trenton age have described ostracode faunules, the Bromide formation of Oklahoma, the Rysedorph conglomerate of New York, and the Wright Bay formation of the Arctic. The Bromide fauna of less than 10 species (Harris, 1931) contains *Euprimitia sanctipauli* and *Krausella arcuata*; *Eridoconcha simpsoni* Harris is quite like *E. oboloides*, but the genus is of long range; *Bromidella reticulata* Harris differs considerably from other known species. Thus, the described

OCCURRENCE OF OSTRACODA IN THE DECORAH FORMATION

Members	Guttenberg							Ion							
Localities	Iowa			Minnesota				Iowa							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
															Page
LEPERDITELLIDAE															
Leperditella macra Ulrich	—	—	—	R	—	—	—	—	—	—	—	—	—	—	241
Leperditella persimilis Ulrich	—	—	—	R	—	—	—	—	—	—	—	—	—	—	241
Schmidtella affinis Ulrich	—	*u*	—	—	A	—	P	—	*r*	—	*c*	*r*	*r*	—	241
Schmidtella brevis Ulrich	*c*	*f*	*A*	R	—	—	—	—	*r*	—	—	*f*	—	*r*	241
Schmidtella incompta Ulrich	*A*	—	*A*	R	*f*	—	—	*c*	*A*	*A*	*A*	*A*	*A*	*A*	242
Schmidtella umbonata Ulrich	—	—	—	—	—	—	F	—	—	—	*r*	—	*a*	*c*	242
Saccelatia arrecta (Ulrich)	—	—	—	—	*u*	—	F	—	—	—	—	—	*r*	—	243
Saccelatia angularis (Ulrich)	—	*u*	—	R	—	—	—	—	*r*	—	—	—	—	—	243
Saccelatia arcuamuralis Kay	—	—	—	—	*r*	—	—	—	*r*	—	—	—	*r*	—	243
Saccelatia bullata Kay	—	—	—	—	—	—	—	—	—	—	—	—	*r*	—	243
Saccelatia cletifera Kay	—	—	—	—	—	*r*	—	—	—	—	—	—	—	—	243
APARCHITIDAE															
Aparchites carinatus Kay	—	—	—	—	—	—	—	—	*r*	—	*r*	—	—	—	244
Aparchites trentonensis Ulrich	—	*f*	*u*	R	*u*	—	—	*f*	*c*	*f*	*a*	*f*	*A*	*a*	244
Aparchites chatfieldensis Ulrich[1]	—	—	—	C	—	—	—	—	—	—	—	—	—	—	244
Aparchites ellipticus Ulrich	—	—	—	R	—	—	—	—	—	—	—	—	—	—	244
Aparchites granilabiatus Ulrich	—	—	—	—	—	—	F	—	—	—	—	—	—	—	244
Aparchites millepunctatus Ulrich	—	—	—	R	—	—	—	—	—	—	—	—	—	—	244
Macronotella multipunctata Kay	*a*	*A*	*a*	—	—	—	—	*r*	*r*	—	—	*u*	*f*	*r*	245
Macronotella rugosa (Jones)	*a*	*A*	*A*	—	*u*	—	—	*a*	*a*	*r*	*a*	*A*	*A*	*u*	245
Macronotella arcta (Ulrich)	*c*	—	—	—	—	—	—	*u*	—	—	*r*	*r*	—	—	245
Paraschmidtella ovata (Kay)	*f*	*a*	*a*	—	*a*	*A*	—	*c*	*c*	*A*	*A*	*c*	*u*	*a*	245
Paraschmidtella centipunctata Kay	—	—	—	—	*a*	—	—	—	—	—	—	—	—	—	246
Paraschmidtella planilateralis Kay	—	—	—	—	—	*A*	—	—	—	—	—	—	—	—	246
Paraschmidtella? uphami (Ulrich)	—	—	—	—	—	—	P	—	—	—	—	—	—	—	245
Eridoconcha oboloides Ulrich and Bassler	—	—	*f*	U	*f*	*u*	U	—	*a*	*f*	*a*	*r*	*a*	*f*	247
PRIMITIIDAE: PRIMITIINAE															
Primitia mammata Ulrich	*A*	*A*	*f*	R	*c*	*a*	—	—	*A*	*a*	*A*	*a*	*A*	*A*	248
Laccoprimitia fillmorensis (Ulrich)	—	—	—	R	—	—	—	—	*a*	*r*	*u*	*A*	—	—	248
Haploprimitia minutissima (Ulrich)	—	—	—	R	—	—	—	—	—	—	—	—	—	—	248
Conchoprimitia symmetrica (Ulrich)	—	—	—	—	*a*	*a*	F	*f*	*a*	—	*r*	*u*	*r*	*u*	249
EURYCHILININAE															
Eurychilina reticulata Ulrich	—	*r*	—	RC	—	*u*	F	*u*	*f*	—	—	*r*	—	*u*	250
Eurychilina incurva Ulrich[2]	—	—	—	—	—	—	F	—	—	—	—	—	—	—	249
Eurychilina parvifrons Kay[2]	—	—	—	—	—	T	—	—	—	—	—	—	—	—	250
Eurychilina ventrosa Ulrich	—	—	—	—	—	*u*	—	—	—	—	*u*	—	—	*u*	250
Eurychilina subradiata Ulrich	—	—	—	—	—	*u*	—	—	—	—	—	—	—	*r*	250
Eurychilina partifimbriata Kay	—	—	—	—	*r*	—	—	—	—	—	—	—	—	—	251
Eurychilina minutifoveata Kay	—	—	—	—	—	—	—	—	—	—	—	—	*u*	—	251
Apatochilina? subaequata (Ulrich)	—	—	—	—	*r*	—	F	*r*	—	—	—	—	—	—	251
Euprimitia sanctipauli (Ulrich)	—	—	*r*	—	—	—	F	—	*u*	—	—	—	—	*r*	252
Euprimitia labiosa (Ulrich)	—	—	*u*	—	—	—	—	—	—	—	*u*	—	*r*	—	252
Euprimitia linepunctata (Kay)	*c*	—	*a*	—	*f*	*c*	—	—	—	*u*	*a*	*u*	*f*	*f*	252
Euprimitia? celata (Ulrich)	—	—	—	R	—	—	—	—	—	—	—	—	—	—	252
Halliella magnapuncta Kay	*r*	—	*u*	—	*r*	—	—	—	—	*r*	—	*u*	—	—	253
Hallatia convexa Kay	*r*	—	*u*	—	—	—	—	—	—	—	*u*	—	*r*	—	253
Hallatia particylindrica Kay	—	—	—	—	—	—	—	—	—	—	*u*	—	*r*	—	253
Hallatia? duplicata (Ulrich)	—	—	—	R	—	—	—	—	—	—	—	—	—	—	253
Winchellatia longispina Kay	—	—	*A*	—	—	—	—	—	—	—	—	—	—	—	254
Winchellatia initialis (Ulrich)	—	—	*r*	R	*r*	—	—	—	—	—	—	—	—	—	254
Winchellatia lansingensis Kay	*A*	*A*	*A*	—	—	—	—	—	—	—	—	—	—	—	254
Winchellatia minnesotensis Kay	—	—	—	—	*f*	—	—	—	—	—	—	—	—	—	255
Parabolbina antecedens Kay	—	—	—	—	*r*	—	—	—	—	—	—	—	—	—	255
Parabolbina carinifera Kay	—	—	—	—	—	—	—	—	—	—	*r*	—	—	—	255
Parabolbina staufferi Kay	—	*u*	*r*	—	*r*	—	—	*r*	—	—	*r*	—	*u*	—	256

[1] Not separated from the preceding species.
[2] Considered dimorphs.

OCCURRENCE OF OSTRACODA IN THE DECORAH FORMATION—*Continued*

Members	Guttenberg							Ion							
Localities	Iowa			Minnesota				Iowa							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
DILOBELLINAE															Page
Dilobella typa Ulrich	—	—	—	—	*A*	*a*	F	—	*f*	—	*r*	—	*r*	—	256
Dilobella simplex Kay	—	—	—	—	—	*r*	—	—	—	—	—	—	—	—	257
Ceratopsis quadrifida (Jones)	—	—	—	RC	*f*	*f*	F	*r*	—	—	—	*r*	*u*	*c*	257
Ceratopsis humilinoda Kay	—	—	—	—	*r*	—	—	—	—	—	—	—	—	—	257
BOLLIINAE															
Bollia subaequata Ulrich	—	—	—	—	—	—	—	*A*	*A*	*A*	*A*	*u*	*a*	*A*	258
Bollia simplex (Ulrich)	—	—	—	R	—	—	—	*u*	—	—	—	—	—	—	258
Maratia micula (Ulrich)	—	—	—	—	—	—	P	—	—	*a*	*r*	—	*r*	*r*	259
Parenthatia punctata (Ulrich)	—	—	—	—	*u*	—	F	—	—	—	*u*	—	*u*	—	259
Parenthatia camerata Kay	—	—	*u*	—	—	—	—	*a*	*c*	*u*	*a*	*c*	*a*	*c*	259
Kiesowia verrucosa Kay	—	—	—	—	*r*	—	—	—	—	—	—	—	—	—	260
Dicranella bicornis Ulrich	—	—	*r*	R	—	—	—	—	—	—	—	—	—	—	260
Dicranella marginata Ulrich	*r*	*r*	—	R	—	—	—	—	*r*	—	*r*	*r*	—	*r*	260
Dicranella spinosa Ulrich	—	—	—	R	—	—	—	—	—	—	—	—	*r*	—	261
Scofieldia bilateralis (Ulrich)	—	—	—	—	—	—	F	—	—	—	—	—	—	*r*	261
AECHMININAE															
Aechmina ionensis Kay	—	—	—	—	*r*	—	—	—	—	—	—	—	—	—	261
PRIMITIOPSIDAE															
Primitiopsis? bella Kay	—	—	—	—	*u*	—	—	*f*	*r*	—	*r*	—	—	—	261
Primitiella constricta Ulrich	—	—	—	—	*a*	*A*	—	*u*	*r*	—	—	*r*	—	—	262
BEYRICHIIDAE: BEYRICHIINAE															
Bromidella depressa Kay	—	—	*f*	—	*a*	*f*	—	*r*	*f*	—	*r*	*u*	*u*	*u*	263
Bromidella rhomboides Kay	—	—	—	—	*u*	—	—	—	*f*	*r*	*u*	*r*	—	—	263
Opikatia emaciata Kay	—	—	*u*	—	—	—	—	—	—	—	*u*	—	—	—	264
Opikatia rotunda Kay	—	—	—	—	*c*	*u*	—	—	—	—	—	*r*	—	*r*	264
TETRADELLINAE															
Tetradella ellipsilira Kay	*f*	—	*a*	—	*f*	*A*	—	*a*	*a*	—	*u*	*A*	*u*	*a*	265
Tetradella ulrichi Kay	—	—	—	RC	—	—	F	—	*r*	—	*u*	—	—	—	265
PIRITELLINAE															
Bellornatia tricollis Kay	—	—	—	—	—	—	—	—	—	—	*r*	—	—	—	265
Bassleratia typa Kay	—	—	—	—	—	—	—	*A*	—	—	*r*	—	—	—	266
Thomasatia falcicosta Kay	*r*	—	*c*	—	*f*	—	—	*A*	*u*	—	*u*	*r*	*u*	*r*	266
Raymondatia goniglypta Kay	—	—	*u*	—	*c*	*f*	—	*c*	*u*	—	—	—	—	—	266
BEECHERELLIDAE															
Krausella curtispina Kay	*r*	—	*r*	—	—	—	—	—	—	—	—	—	—	—	267
Krausella arcuata Ulrich[3]	*f*	*a*	*A*	—	*f*	—	—	*r*	—	*r*	*r*	—	*r*	*r*	267
Rayella calvini Kay	—	—	—	—	*f*	—	—	—	*r*	—	—	—	—	—	268
BAIRDIIDAE															
Bythocypris cylindrica (Hall)	—	*f*	*A*	R	*a*	*A*	—	*f*	*u*	*u*	*u*	*a*	*c*	*f*	268
Bythocypris curta Ulrich[1]	—	—	—	R	—	—	—	—	—	—	—	—	—	—	268
Bythocypris granti Ulrich[1]	—	—	—	R	—	—	—	—	—	—	—	—	—	—	268

A, very abundant, more than 100 specimens per thousand; *a*, abundant, less than 100; *c*, common, less than 40; *f*, frequent, less than 20; *u*, uncommon, less than 10; *r*, rare, less than 5; C, *Ctenodonta* zone; F, fucoid and *Chasmatopora* zones; R, *Rhinidictya* zone; T, type specimen; P, listed from basal Prosser ("*Clitambonites* zone") but probably from very top of the fucoid zone of the Decorah formation; U, exact horizon not reported.

[3] Including other imperfect specimens of *Krausella* and *Rayella*.

fauna of the Bromide does not bear sufficient resemblance to be useful in demonstrating their supposedly synchronous deposition. The fauna of the Rysedorph limestone boulders (Ruedemann, *1901*) contains 15 species that are found in three types of matrix, all of which seem of Black River or lower Trenton age. No one of the species is clearly identical with any Decorah form, though there are representatives of

several Decorah genera. The Arctic lower Trenton faunas (Teichert, 1937) contain about 20 species of ostracodes; *Aparchites ellipticus* of Teichert is questionably identical with the Decorah holotype, and *Rayella canadensis* (Teichert) is similar to *R. calvini* of the Decorah.

The largest faunas of Ostracoda from beds of middle Ordovician age have been described from the Uhaku and Kukruse formations of Estonia (Bonnema, 1909; Öpik, 1937). That these formations are of about the age of the Decorah has been recognized by Bassler (1911) and by Raymond (1916). The more recent studies of the Brachiopoda by Öpik seem to support this correlation. But of the nearly 100 species of ostracodes in the two formations, not one is clearly identical with an American form; and the most similar forms are in most cases doubtfully congeneric. Among the closest resemblances are those of *Conchoprimitia tolli* (Bonnema) to *C. symmetrica*, of *Pseudostrepula kuckersiana* (Bonnema) to *Bassleratia typa*, *Entomis obliqua* Krause and its associates to *Winchellatia lansingensis*, and of *Kiesowia pernodosa* Öpik to *K. verrucosa*.

On the other hand, many of the species in the Decorah fauna are strikingly similar to species from the Cincinnatian of the Cincinnati region, and a number of the genera are represented by species that are obviously closely related to the older Decorah forms.

The species of Ostracoda in the Decorah fauna are characteristic of lower Trenton faunas in the interior of North America; the limits of the province cannot be defined because there is insufficient information on the faunas of formations of comparable age. The approximately synchronous faunas of the Baltic region of Europe belong in a distinct province; there seems to have been little intermigration of the faunas, and both must have been derived from earlier faunas of undiscovered character and position. The descendants of the Decorah forms continued to occupy the interior North American

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EXPLANATION OF PLATE 29

All figures approximately ×30

FIGS. *1–4*—*Schmidtella affinis* Ulrich, Ion member, Cannon Falls, Minn. *1*, *2*, Lateral and interior views of topotype 27600C, left valve. *3*, *4*, Lateral and dorsal views of topotype 27601O, bivalved. (p. 241)

5, *6*—*Schmidtella incompta* Ulrich, upper part of the Guttenberg member, sec. 13, Glenwood Township, Iowa. Dorsal and lateral views of hypotype 27602C, left valve. (p. 242)

7, *8*—*Schmidtella brevis* Ulrich, upper part of the Guttenberg member, sec. 13, Glenwood Township, Iowa. Dorsal and lateral views of hypotype 27603C. (p. 241)

9–11—*Schmidtella umbonata* Ulrich, lower part of the Ion member, sec. 13, Glenwood Township, Iowa. *9*, Lateral view of hypotype 27604C, left valve. *10*, *11*, Lateral and interior views of hypotype 27605C, left valve. (p. 242)

12–16—*Saccelatia arrecta* (Ulrich), Ion member, Canon Falls, Minn. *12–14*, Dorsal, lateral, and ventral views of hypotype 27606C, left valve. *15*, *16*, Lateral and ventral views of hypotype 27607C, left valve. (p. 243)

17–20—*Saccelatia angularis* (Ulrich), sec. 13, Glenwood Township, Iowa. *17–19*, Dorsal, lateral, and ventral views of hypotype 27608C, left valve, lower part of the Guttenberg member. *20*, Ventral view of hypotype 27609C, bivalved, upper part of the Guttenberg member. (p. 243)

21, *22*—*Saccelatia bullata* Kay, n. sp., middle part of the Guttenberg member, sec. 13, Glenwood Township, Iowa. Lateral view of left valve and ventral view of holotype 27568C, bivalved. (p. 243)

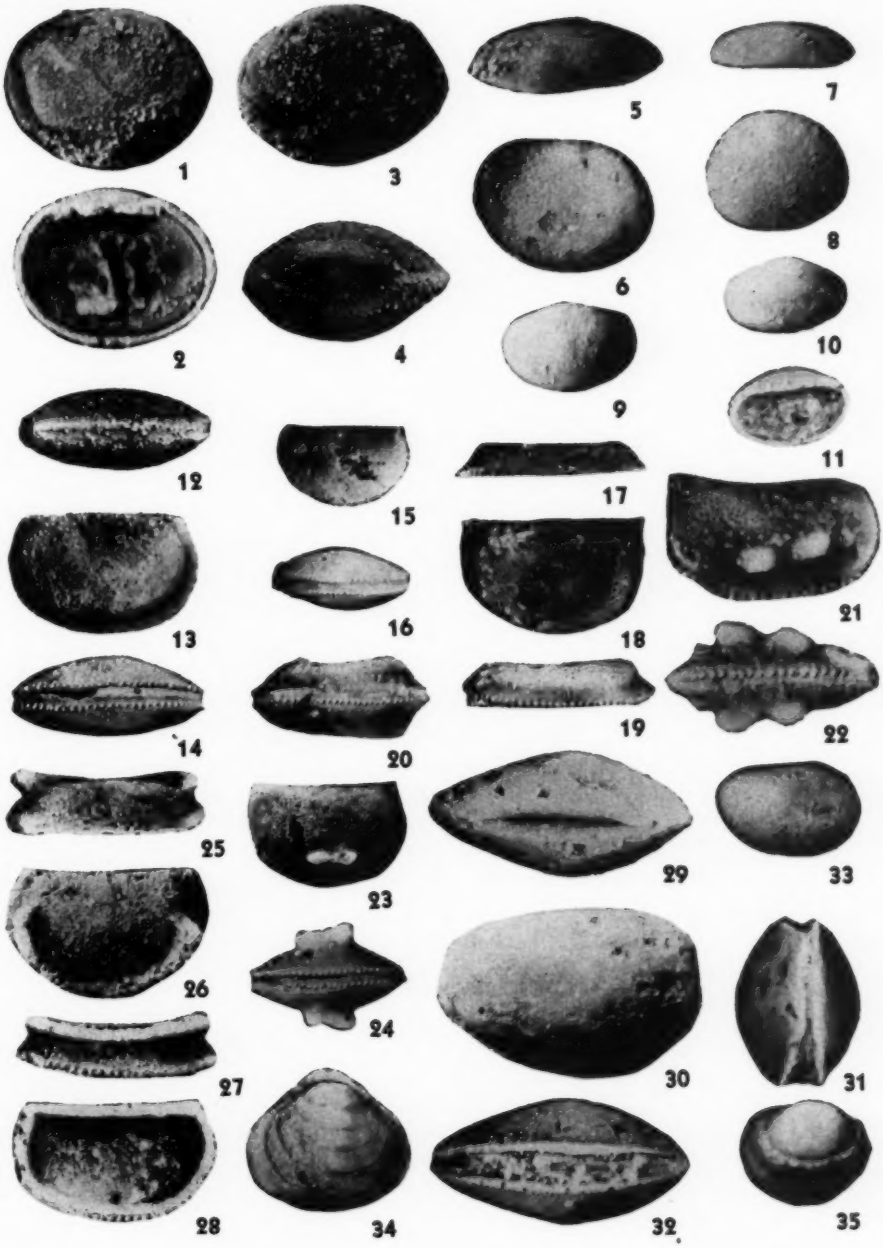
23, *24*—*Saccelatia cletifera* Kay, n. sp., Ion member, Ellsworth, Wis. Lateral view of left valve and ventral view of holotype 27659C, bivalved. (p. 243)

25–28—*Saccelatia arcuamuralis* Kay, n. sp., Ion Member, Cannon Falls, Minn. Dorsal, lateral, ventral, and interior views of holotype 27599C, left valve. (p. 243)

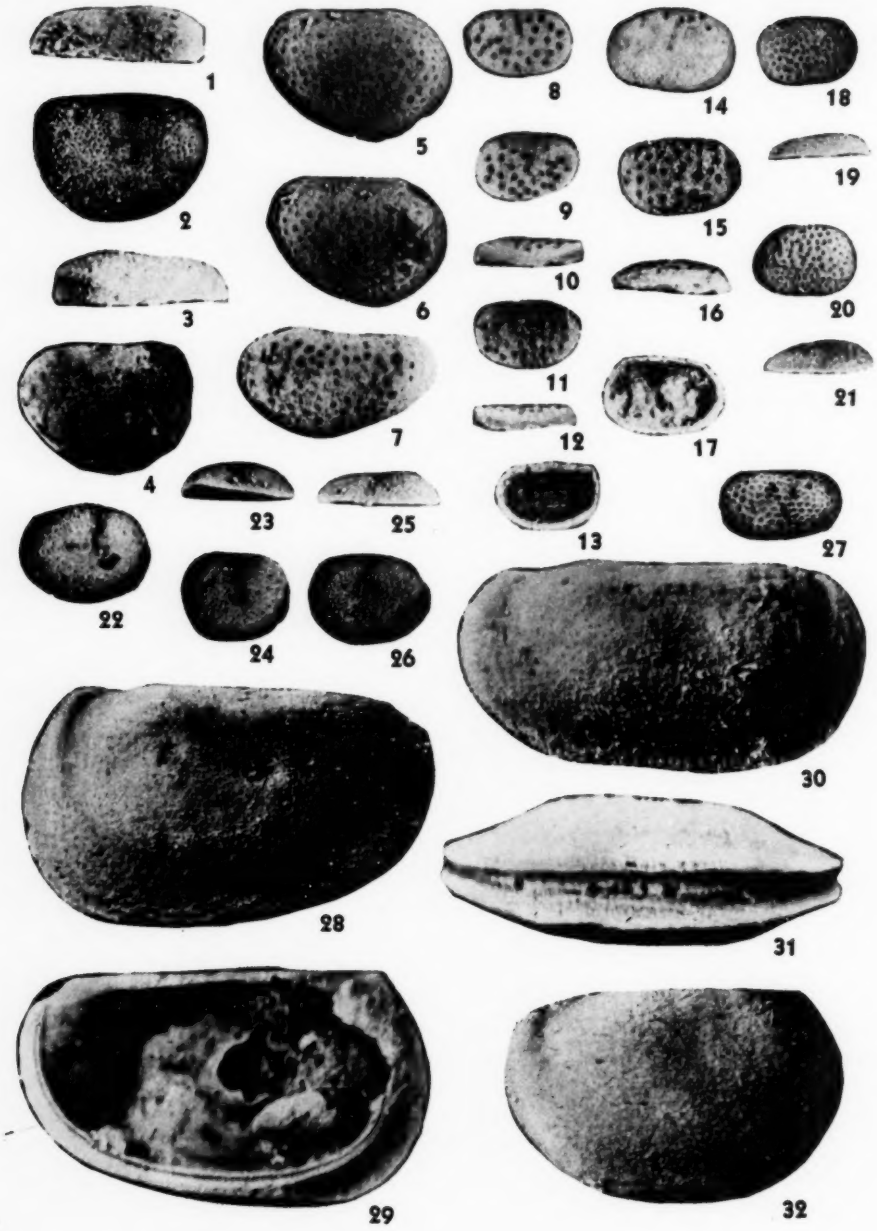
29–32—*Aparchites carinatus* Kay, n. sp., Lower part of the Ion member, sec. 6, Glenwood Township, Winneshiek County, Iowa. Dorsal view, lateral view of left valve, anterior, and ventral views of holotype 27571C, bivalved. (p. 244)

33—*Aparchites trentonensis* Ulrich, Ion member, Cannon Falls, Minn. Lateral view of hypotype, 27610C, left valve. (p. 244)

34, *35*—*Eridoconcha oboloides* Ulrich and Bassler, Ion member, Cannon Falls, Minn. *34*, Lateral view of hypotype 27611C, bivalved. *35*, Lateral view of hypotype 27672C, bivalved. (p. 247)



Kay, Ordovician (Decorah) Ostracoda



Kay, Ordovician (Decorah) Ostracoda

province throughout Ordovician time, with little dilution by migration from other provinces.

DIMORPHIC STRUCTURES

The Decorah fauna contains a number of species in which there are two forms, one of which consistently bears structures that the other lacks. These are believed to be of sexual significance; the simpler forms are referred to as male valves, the more complex as females. With the exception of the genue *Primitiella*, the structural differences are in the same end of the valves as the principal sulcus or the muscle spot. Ulrich and Bassler (1923) considered the end bearing the prominent sulcus to be the posterior, whereas Bonnema (1932) and Swartz (1936) call it the anterior. In the present study, Ulrich and Bassler's orientation is followed, principally that the systematic descriptions may conform to those previously published; the evidence seems inconclusive, and the orientation adopted may be reversed.

The types of structures born by the female valves are several. In *Euprimitia*, the posteroventral border is thickened and has a peripheral channel. *Tetradella* has several partitions or "loculi" along the posterior and posteroventral margins, isolating as many as five subcircular, peripherally opening pits; this dimorphism might be termed isomorphism, for there are intermediate stages having few or little-developed pits. *Dilobella* bears similar pits formed by the partitioning of the marginal channel.

Marginal frills, flanges and pouches are present in several genera. In *Parabolbina*, a slightly convex flange extends along the ventral and posterior borders. Comparable flanges are present in *Winchellatia* and *Dicranella*. The genotype of *Eurychilina*, *E. reticulata*, seems trimorphic; the typical form bears a broad, laterally concave, striate frill on the free margins; a second form, *E. parvifrons*, has only a very narrow flange; and in the third form, *E. incurva*, a somewhat narrower frill than in the typical form is laterally convex along the ventral border, forming an internal arcuate marginal pouch. *Conchoprimitia* has a convex lobe within the free margins in both male and female forms;

EXPLANATION OF PLATE 30

All figures approximately ×30

FIGS. *1–3—Macrontella multipunctata* Kay, n. sp., upper Guttenberg member, sec. 13, Glenwood Township, Iowa. Dorsal, lateral, and ventral views of holotype 27574C, left valve. (p. 245)

4—Macronotella elongata Teichert, Cape Webster, North Greenland. Lateral view of holotype, left valve, after Teichert (1937, pl. 5, fig. 13). (p. 245)

5, 6—Macronotella rugosa (Jones), middle part of Ion member, sec. 13, Glenwood Township, Iowa. *5*, Lateral view of hypotype 27617C, left valve. *6*, Lateral view of hypotype 27618C, bivalved. (p. 245)

7—Macronotella arcta (Ulrich), middle part of Ion member, sec. 6, Glenwood Township, Iowa. Lateral view of hypotype 27619C, bivalved. (p. 245)

8–13—Paraschmidtella planilateralis Kay, n. sp., Ion member, Ellsworth, Wis. *8*, Lateral view of paratype 27612C, left valve. *9*, *10*, Lateral and ventral views of paratype 27613C, left valve. *11–13*, Dorsal, lateral, and ventral views of holotype 27573C, left valve. (p. 246)

14–17—Paraschmidtella ovata (Kay), upper part of Ion member, Church, Iowa. *14*, Lateral view of hypotype 27614C, left valve. *15–17*, Lateral, ventral, and interior views of hypotype 27615C, left valve. (p. 245)

18–21—Paraschmidtella centipunctata Kay, n. sp., Ion member, Cannon Falls, Minn. *18*, *19*, Lateral and ventral views of paratype 27616C, left valve. *20*, *21*, Lateral and ventral views of holotype 27572C, left valve. (p. 246)

22—Primitia mammata Ulrich, Ion member, Cannon Falls, Minn. Lateral view of hypotype 27621C, left valve. (p. 248)

23–26—Laccoprimitia fillmorensis (Ulrich), Ion member, Cannon Falls, Minn. *23*, *24*, Dorsal and lateral views of hypotype 27622C, right valve. *25*, *26*, Dorsal and lateral views of hypotype 27623C, right valve. (p. 248)

27—Primitiopsis? bella Kay, n. sp., Ion member, Cannon Falls, Minn. Lateral view of holotype 27576C, left valve.

28–32—Conchoprimitia symmetrica (Ulrich), Ion member. *28*, *29*, Lateral and interior views of hypotype 27624C, right valve, Cannon Falls, Minn. *30*, *31*, Lateral view of left valve and ventral view of hypotype 27626C, bivalved, Ellsworth, Wis. *32*, Lateral view of hypotype 27627C, left valve, Cannon Falls, Minn. (p. 249)

in the female, this lobe is relatively broad, and its peripheral part extends beyond the contact as a flange on the ventral and posterior margins.

In *Opikatia* there are three swollen nodes along the posterior border of the valve, the marginal outline being like that in the male valve. *Bellornatia* has similar intramarginal lobes. And in *Primitiella*, the anterior half of the female valve is relatively thickened, rising steeply from the anterior margin; in this respect, the genus resembles those in the family Kloedenellidae.

Similar dimorphic structures seem to have developed in several lines of descent; there is parallelism in dimorphic structures. Forms bearing similar dimorphic structures may not be more closely related than to forms having differing structures. The male forms of the genera *Biflabellum* Öpik (Ordovician of Estonia) and *Dibolbina* Ulrich and Bassler (Silurian of the Appalachian region) are quite alike, bearing broad, striate frills on their free margins, with very similar central characters; but whereas the female form of *Biflabellum* has a narrower, laterally convex marginal pouch, that of *Dibolbina* has a posteroventral intramarginal subcircular lobe. It seems that if *Dibolbina* is not a descendant of *Biflabellum*, they have a common ancestry. *Euprimitia*, the type of which is the Decorah *E. sanctipauli*, has a posterior marginal groove in the female valve; *Bolboprimitia fissurella* Ulrich and Bassler (Silurian of the Appalachian region) resembles *E. labiosa* of the Decorah fauna, but has a ventral pouch. The Decorah form, *Bromidella depressa* has female valves with a ventral convex lobe, corresponding to an internal arcuate pouch; although the male valve is not identical with that of such species as *Beyrichia kloedeni* McCoy (Silurian of Ireland) it has similar lobation, and is thought to be closely related; but the typical *Beyrichia* has a bulbose posteroventral intramarginal lobe in the female valve.

In classification, genera having anterior dimorphism have been segregated from those having dimorphic structures in the posterior. If this be a correct interpretation, there seem to be some cases of parallelism in lobation. *Uhakiella* Öpik (Ordovician of Estonia) has a brood pouch like that of *Bromidella*, though the central lobation is dissimilar; but *Jonesina bolliaformis* Ulrich and Bassler (Pennsylvanian) has male valves very like those of *Uhakiella*, but female valves having a thickened anterior lobe such as characterizes the Kloedenellidae.

CLASSIFICATION OF GENERA

The genera of Decorah Ostracoda were placed in families by Ulrich (1894, p. 632); later writers have presented differing classifications (Ulrich and Bassler, 1908, 1923, Bassler and Kellett, 1934; Bouček, 1936; Swartz, 1936; Öpik, 1937). The changes in classification proposed in this study result principally from additional knowledge of the genera.

Characters of several types have been considered of sufficient importance to separate families and subfamilies. Marginal structures producing dissimilarities in paired valves characterize the Leperditellidae, Bairdiidae and Beecherellidae. Most of the remaining families fall in the superfamily Beyrichiacea Ulrich and Bassler. These have been separated principally on the valve lobation; dimorphism has been considered of generic importance, though the anterior dimorphism of the Primitiopsidae seems to warrant their separation from the other genera having posterior dimorphism. Surface characters of smoothness, pitting, punctation and granulation have been considered of specific or generic importance, though genera in the same subfamilies tend to have similar types of ornamentation.

The classification adopted, with the diagnostic features of each family or subfamily, and the Decorah genera included, is as follows:

Family LEPERDITELLIDAE Ulrich and Bassler, 1906. Valves essentially similar, but with ventral overlap; surface rather regularly convex, without distinct sulcus: *Leperditella*, *Schmidtella*, *Saccelatia*.

Family APARCHITIDAE (Jones), 1901. Valves similar; surface rather regularly convex, without distinct sulcus, but with subcentral or posterocentral muscle spot: *Aparchites*, *Paraschmidtella*, *Macronotella*. *Eridoconcha* is doubtfully associated with this family.

Family PRIMITIIDAE Ulrich and Bassler, 1923. Valves similar; bearing a distinct posterocentral pit or sulcus; dimorphism posterior when represented.

Subfamily PRIMITIINAE (Ulrich and Bassler), 1923. Surface rather regularly convex, having pit or short, linear, dorsal sulcus: *Primitia, Laccoprimitia, Haploprimitia, Conchoprimitia.*

Subfamily EURYCHILININAE Ulrich and Bassler, 1923. Surface having posteriorly concave posterodorsal sulcus in front of rounded node: *Eurychilina, Euprimitia, Halliella, Hallatia, Parabolbina, Winchellatia. Apatochilina* is included within the subfamily because of its similarity to *Eurychilina*, though it does not have the typical sulcus.

Subfamily DILOBELLINAE Kay, new subfamily. Surface having broad, deep sulcus extending diagonally from middorsal toward posteroventral: *Dilobella, Ceratopsis.*

Subfamily BOLLIINAE Bouček, 1936. Surface tending to be relatively depressed, bearing nodes, spines or ridges on each side of the sulcus; tending to be relatively depressed centrally: *Bollia, Kiesowia, Dicranella. Maratia* and *Parenthatia* are doubtfully included, for they seem more similar to *Bollia* than to the typical genera in other subfamilies. *Scofieldia* may belong in the subfamily; if it properly does, the subfamily name becomes Drepanellinae Ulrich and Bassler, 1923.

Subfamily AECHIMININAE Bouček, 1936. Surface bearing dorsolaterally projecting dorsal spine; lacking posterocentral sulcus: *Aechmina.*

Family PRIMITIOPSIDAE Swartz, 1936. Valves similar; bearing posterocentral pit or sulcus; dimorphism anterior: *Primitiopsis, Primitiella.*

Family BEYRICHIIDAE Ulrich, 1894. Valves similar; surface multilobed, bearing prominent posteromedian lobe or node; dimorphism posterior or posteroventral when represented.

Subfamily BEYRICHIINAE (Ulrich), 1894. Surface essentially trilobate, anterior lobe tending to be horizontally divided: *Bromidella, Opikatia.*

Subfamily TETRADELLINAE (Swartz), 1936. Surface essentially trilobate, anterior and posterior lobes vertically divided: *Tetradella.*

Subfamily PIRETELLINAE (Öpik), 1937. Surfacing having one or more arcuate ridges partially surrounding the posteromedian node: *Bellornatia, Bassleratia, Thomasatia. Raymondatia* is associated with the subfamily, though its character seems quite distinct from any other described genus.

Family BEECHERELLIDAE Ulrich, 1894. Valves dissimilar, with ventral overlap, and in some genera, overlap on other margins; posterior margin of one valve having spinelike attenuation: *Krausella, Rayella.*

Family BAIRDIIDAE Sars, 1887. Valves dissimilar; with ventral overlap, and in some genera, overlap on other margins; outline suboval: *Bythocypris.*

SYSTEMATIC DESCRIPTIONS

Family LEPERDITELLIDAE Ulrich and Bassler, 1906

Leperditellidae ULRICH and BASSLER, *1906*, U. S. Nat. Mus., Proc., vol. 30, p. 149.

Aparchitidae (part) ULRICH and BASSLER, *1923*, Maryland Geol. Surv., Silurian, p. 296.—KAY, *1934*, Jour. Paleontology, vol. 8, p. 331.

Genus LEPERDITELLA Ulrich, 1894

Two species, *L. macra* Ulrich and *L. persimilis* Ulrich have been described by Ulrich (1894) from the Guttenberg shale (*Rhinidictya* zone) of Minnesota. These were not found in faunules from the equivalent beds in Iowa, nor in the Ion member.

Genus SCHMIDTELLA Ulrich, 1892

The four species of this genus, *S. affinis, S. brevis, S. incompta* and *S. umbonata*, were all described by Ulrich (1894) from Minnesota. A shallow umbonal depression that is present in some of these forms has not been previously reported; in character it is similar to the more prominent sulcus in *Primitia mammata* Ulrich.

SCHMIDTELLA AFFINIS Ulrich, 1894
Plate 29, figures 1–4

Schmidtella affinis ULRICH, *1894*, Geology Minnesota, vol. 3, pt. 2, p. 641, pl. 43, figs. 45–47. ("Galena shales"—probably Ion member, Decorah formation, near Cannon Falls, Minn.)

Valves medium in size, similar. Outline suboval, dorsal margin obscuring hinge, which is short, centered posterior to midlength; dorsal margin broadly curved, meeting free margins somewhat angularly; free margins regularly curved, anterior most sharply, being extended anteroventrally. Surface quite convex, rising steeply from dorsal margin to distinct umbo posterior to middorsal; less steeply from free margins, which frequently are bordered by a shallow furrow; surface smooth. Contact not observed in paired valves; but right and left valves each may have distinct channel on interior within margin, suggesting that overlap is not consistent. Valves relatively thick shelled.

Holotype no. 41296 US. (Ulrich): length, 0.97 mm; width 0.72 mm; thickness one valve, 0.22 mm.

Found locally in Guttenberg and Ion members in Iowa and Minnesota; most abundant at type locality.

SCHMIDTELLA BREVIS Ulrich, 1894
Plate 29, figures 7, 8.

Schmidtella brevis ULRICH, *1894*, Geology Minnesota, vol. 3, pt. 2, p. 642, pl. 45, figs. 34, 35. ("Lower part of Trenton shales"—Guttenberg member, Decorah formation, Fountain, Minn.)

Valves small, similar. Outline suboval,

broadest posteriorly; hinge short, centered little posterior to midlength; dorsal margin broadly arcuate, somewhat truncating; anterior margin somewhat extended ventrally, similar to but more sharply curved than posterior. Surface regularly convex, rising steeply from dorsal margin, gently from free margins; greatest thickness posterodorsal; surface smooth. Contact not observed in paired valves; margins of two valves similar.

Holotype no. 41299 US. (Ulrich): length, 0.8 mm; width, 0.65; thickness one valve, 0.2 mm.

The species has been found only in the Guttenberg member, in which it is frequent in Iowa.

SCHMIDTELLA INCOMPTA Ulrich, 1894
Plate 29, figures 5, 6

Schmidtella umbonata ULRICH, *1894*, Geology Minnesota, vol. 3, pt. 2, p. 642, pl. 45, figs. 27, 32, 33. ("Lower part of the Trenton shales"—Guttenberg member, Decorah formation, near Fountain, Minn.)

Valves medium in size, similar. Outline dorsally truncate-elliptical; hinge straight, short, about half valve length, center a little posterior to midlength; free margins regularly curved, anterior somewhat more sharply than posterior, which meets dorsal subangularly. Surface rather regularly convex, rising rather steeply from dorsal margin, more gently from free margins; greatest thickness posterodorsal to midvalve, forming an umbo having a very shallow dorsally trending depression; surface smooth. Contact not observed in paired valves; free valves not evidencing overlap.

Holotype no. 41298 US. (Ulrich): length, 1.1 mm; width, 0.8 mm; thickness one valve, 0.28 mm.

This is one of the most abundant and persistent species in the Decorah formation; similar forms have been found in lower and middle Trenton faunules from Ontario and from the Spechts Ferry member of the Platteville formation in Iowa. The persistent umbonal depression in this species has not been described previously. The species *S. subaequalis* Ulrich, from shales in the Prosser formation, is described as "a trifle more convex and blunter at the dorsal edge, slightly shorter and less equilateral".

SCHMIDTELLA UMBONATA Ulrich, 1894
Plate 29, figures 9, 11

Schmidtella umbonata ULRICH, *1894*, Geology Minnesota, vol. 3, pt. 2, pl. 641, figs. 36–38. ("Upper third of Trenton shales"—Ion member, Decorah formation, St. Paul, Minn.)

Valves small, similar. Outline subelliptical, dorsal margin arcuate but somewhat truncating; hinge short, straight, obscured by dorsal margin, having narrow cardinal area; free margins regularly curved, anterior slightly more extended than posterior; ventral margin broadly arcuate. Surface rather regularly convex, rising steeply from overhanging dorsal margin to middorsal umbo, more gently from narrow, peripherally facing border of free margins; surface smooth, having faint dorsally directed umbonal depression corresponding to internal partition frequently evidenced by translucent area from exterior. Contact with right valve overlapping left, though both margins extend normal to the plane of the valves. Valves thin.

Holotype no. 41301 US. (Ulrich): length, 0.8 mm; width, 0.59 mm; thickness one valve, 0.23 mm.

This species is frequent in the Ion member in Iowa, but has not been collected in central Minnesota.

Genus SACCALATIA Kay, n. gen.

Genotype *Aparchites arrectus* ULRICH, *1894*, Geology Minnesota, vol. 3, pt. 2, p. 646, pl. 43, figs. 35–36. ("Upper third of Trenton shales" – Ion member, Decorah formation, St. Paul, Minn.)

Valves small, similar; outline deeply truncate elliptical; hinge straight, relatively long; ends subequal. Valves quite convex, surface rising gently from dorsal margin to greatest thickness ventral to midheight; surface smooth or with fine reticulation, having ventral swellings, flanges and projections in some species. Contact with left valve overlapping; bordered by marginal granules in some species.

The several species placed in this genus differ from species of *Aparchites* in having relatively long hinge lines and in being thickened ventrally. Forms having ventral swellings, flanges and projections seem otherwise closely similar to the smooth and simple-surfaced genotype. The generic name is from the Latin *saccelus*, a small pouch.

Five species from the Decorah formation are referred to the genus: *S. arrecta* (Ulrich), the genotype, *S. angularis* (Ulrich) and the new species *S. arcuamuralis*, *S. bullata* and *S. cletifera*.

SACCELATIA ARRECTA (Ulrich), 1894
Plate 29, figures 12–16

Aparchites arrectus ULRICH, *1894*, Geology Minnesota, vol. 3, pt. 2, p. 646, pl. 43, figs. 35–36. ("Upper third of Trenton shales"—Ion member, Decorah formation, St. Paul, Minn.)

Valves of medium size, similar. Outline truncate-suboval; hinge straight, nearly as long as valve; dorsal margin straight, joining anterior margin with somewhat obtuse angle; posterior margin with angle approaching right angle; free margins regularly curved, ends subequal; retral swing very slight. Surface rising regularly from margins, most steeply along venter, to greatest thickness ventral to valve center; surface seems smooth; free margins having about 40 small granules, separated from contact by shallow channel. Contact with overlap of left valve on free margins.

Holotype no. 41836 US. (Ulrich): length, 0.81 mm; width, 0.53 mm; thickness one valve, 0.11 mm. The size of the species is quite variable.

Frequent in the Ion member near Cannon Falls, Minnesota; rare elsewhere.

SACCELATIA ANGULARIS (Ulrich), 1894
Plate 29, figures 17–20

Moorea angularis ULRICH, *1894*, Geology Minnesota, vol. 3, pt. 2, p. 682, pl. 43, fig. 89, pl. 46, figs. 15, 16. (*Rhinidictya* beds—Guttenberg member, Decorah formation, Minneapolis, Minn.)

Valves medium in size, similar. Outline deeply truncate subelliptical; dorsal margin nearly as long as valve length, having terminal "ears"; hinge long; free margins regularly curved; ends subequal. Surface rising gently from dorsal margin, steeply from ventral, to arcuate swelling extending from within anterior margin to within the posterior, approaching venter closely; central and dorsal areas relatively depressed; surface seems smooth except on arcuate ridge, which bears linear pits. Contact not seen in paired valves; bordered by granuled margin.

Holotype no. 41685 US. (Ulrich): length, 0.67 mm; width, 0.40 mm; thickness one valve, 0.23 mm.

Infrequent in the Guttenberg member in Iowa and Minnesota; a single specimen was collected from the Ion in Iowa.

SACCELATIA ARCUAMURALIS Kay, n. sp.
Plate 29, figures 25–28

This species is most similar to *S. angularis* (Ulrich). In the position of the arcuate swelling within the ventral margin of that form, *S. arcuamuralis* has a peripherolaterally extending flange separated from the granuled margin by a broad, channel-like depression. The surface is not well preserved, but seems smooth.

Holotype no. 27599 C. (Ion member west of Ellsworth, Wis.): length, 0.96 mm; width, 0.53 mm; thickness one valve, 0.25 mm.

The species is rare in the Ion member; specimens have been collected at Ellsworth, Wis. and at two localities in Iowa.

SACCELATIA BULLATA Kay, n. sp.
Plate 29, figures 21–22

Valves medium in size, similar. Outline truncate-subelliptical, posterodorsally extended. Dorsal margin slightly concave; hinge long; dorsal margin meeting anterior in broad angle, posterior nearly at right angle. Surface rising gently from margins, somewhat depressed centrodorsally; with two conspicuous nodes in midventer, the anterior and larger separated from the posterior by narrow depression; surface finely pitted. Contact not clear; with projecting granules on free margins, bordered laterally by narrow channel.

Holotype no. 27569 C. (6 feet from base of Ion, sec. 13, Glenwood Township, Winneshiek County, Iowa): length, 1.0 mm; width, 0.55 mm; thickness, 0.52 mm (specimen somewhat crushed).

The holotype is the only collected specimen.

SACCELATIA CLETIFERA
Kay, n. sp.
Plate 1, figures 23–24

This species is very similar to *S. arrectus* (Ulrich) in its shape and the general form of the valves. The surface bears two nodes in the median-ventral, the anterior and larger being just anterior to midlength, and con-

nected by a low ridge with the posterior, so as to form a cleat-like projection; the surface has fine reticulating pits.

Holotype no. 27570 C. (Ion member, 45 feet above top of McGregor limestone, near Ellsworth, Wis.): length, 0.73 mm; width, 0.45 mm; thickness, 0.50 mm.

The holotype, a perfect specimen, is the only one collected. The species differs from *S. bullata* Kay in its having angular cardinal extremities and in the relatively smaller size and connection of the nodes.

Family APARCHITIDAE (Jones), 1901

Aparchitinae JONES, *1901*, in CHAPMAN, Annals and Mag. Nat. History, ser. 7, vol. 7, p. 147.
Aparchitidae ULRICH and BASSLER, *1923*, Maryland Geol. Survey, Silurian, p. 296.

Genus APARCHITES Jones, 1889

Two species of the genus *Aparchites* have been recognized in the collected faunules, *A. carinatus* Kay, a new species, and *A. trentonensis* Ulrich. Of other species described by Ulrich (1894), *A. ellipticus* and *A. millepunctatus*, found in the Guttenberg (*Rhinidictya* zone) and *A. granilabiatus*, in the Ion (fucoid zone) of Minnesota have not been recognized; *A. chatfieldensis*, described from the Guttenberg (*Ctenodonta* zone) may be represented among forms identified as *A. trentonensis*.

APARCHITES CARINATUS Kay, n. sp.
Plate 29, figures 29–32

Valves medium in size, similar. Outline suboval, narrowing anteriorly; dorsal margin broadly curved, obscuring hinge, joining free margins in interrupted curve; free margins regularly curved, anterior most sharply; retral swing slight. Hinge short, about three-fifths valve length, bordered by laterodorsally extending narrow cardinal areas; narrow flange on free margins obscuring contact. Surface rising regularly from margins to greatest thickness a little posterior to valve center; shallow groove within flange on free margins. Contact seems plane, bordered by row of about 40 granules on free margins.

Holotype no. 27571 C. (Upper Ion, sec. 6, Glenwood Township, Winneshiek County, Iowa): length, 1.22 mm; width, 0.75 mm; thickness, 0.54 mm.

Two specimens have been found in the Ion member in Iowa. The species is similar to *A. concinnus* Jones, which is described as lacking the marginal flange and the granuled border.

APARCHITES TRENTONENSIS
Ulrich, 1894
Plate 29, figure 33

Aparchites minutissimus trentonensis ULRICH, *1894*, Geology Minnesota, vol. 3, pt. 2, p. 646, pl. 43, figs. 18–20. ("Middle third of Trenton shales"—Guttenberg member, near Fountain, Minnesota; and "top of Galena shales"—Ion member, near Cannon Falls, Minn.).

Valves rather small, similar. Outline suboval, dorsal margin straight; hinge about three-fifths valve length; free margins regularly curved, anterior much more sharply than posterior; retral swing obvious. Surface rising steeply from margins to broadly convex lateral surface; greatest thickness subcentral; surface smooth. Contact not observed in paired valves, seems plane.

Syntype (Cannon Falls) no. 82394 US. (Ulrich): length, 0.85 mm; width, 0.54 mm; thickness one valve, 0.16 mm.

The species is persistent and frequent in both the Guttenberg and Ion members. The specimens may include representatives of *A. chatfieldensis* Ulrich.

Genus MACRONOTELLA Ulrich, 1894

Punctaparchites KAY, *1934*, Jour. Paleontology, vol. 8, p. 331.

Genotype, *Macronotella scofieldi* ULRICH, *1894*, Geology Minnesota, vol. 3, pt. 2, p. 684, pl. 43, figs. 30–34. (McGregor member, Platteville formation, Cannon Falls, Minn.)

Valves medium in size, similar. Outline truncate-oval; hinge typically long. Surface rather regularly convex; lateral surface distinctly punctate, except for subcircular smooth "muscle spot." Contact plane.

The species *Cytheropsis rugosus* Jones, genotype of *Punctaparchites*, differs from *Macronotella* principally in its having a relatively short hinge line; it resembles the latter in general form, in being punctate, and in bearing a subcircular muscle spot, and for these reasons it is placed in synonymy. In addition to *Macronotella* and the closely related *M. arcta* Ulrich, the Decorah fauna contains the new species *M. multipunctata*.

The species *Punctaparchites ovatus* Kay is placed in the genus *Paraschmidtella* Swartz.

MACRONOTELLA MULTIPUNCTATA
Kay, n. sp.
Plate 30, figures 1–3

Valves medium in size, similar. Outline truncate subcircular; hinge quite long; dorsal margin straight, curving regularly but sharply into anterior and posterior margins; free margins regularly curved, posterior more broadly than anterior; retral swing slight. Valves quite high, rising steeply from dorsal and anterior, abruptly from posterior and posteroventral; surface with slightly depressed broad sulcus extending dorsally from center; lateral surface bearing many irregularly to quincunxially arranged punctae except in circular central muscle spot and in broadening area dorsal to it; greatest thickness near posterior margin. Contact seems simple, border somewhat thickened, in some specimens bearing a row of small granules.

Holotype no. 27574 C. (Guttenberg member, sec. 13, Glenwood Township, Winneshiek County, Iowa): length, 0.78 mm; width, 0.56 mm; thickness one valve, 0.25 mm.

One of the most common and persistent fossils in the Guttenberg member in northeastern Iowa; rare in the Ion member in Iowa and Minnesota. The species is most like *M. elongata* Teichert (pl. 30, fig. 4), in which the muscle spot is smaller, and posteroventral in position.

MACRONOTELLA RUGOSA (Jones), 1858
Plate 30, figures 5, 6

Cytheropsis rugosus JONES, *1858*, Annals and Mag. Nat. History, ser. 3, vol. 1, p. 249, pl. 10, fig. 5. (Lower Trenton Rockland limestone, Paquette Rapids, Quebec.)
Cytherella? rugosa ULRICH, *1894*, Geology Minnesota, vol. 3, pt. 2, p. 686, pl. 43, figs. 21–24.
Punctaparchites rugosus KAY, *1934*, Jour. Paleontology, vol. 8, p. 331, pl. 44, figs. 1–4.

The latter description is fairly adequate, except that the description omits mention of the nonpunctate area anteroventral to the valve center.

The species is common in the Guttenberg and Ion members at many localities and has been found in lower Trenton faunules in Ontario and New York. Ulrich described the species from the *Nematopora* zone of the Prosser formation. The species differs distinctly from *M. multipunctata* in its more elongate form, relatively shorter hingeline, and larger and fewer punctae.

MACRONOTELLA ARCTA (Ulrich), 1894
Plate 30, figure 7

Cytherella? rugosa arcta Ulrich, *1894*, Geology Minnesota, vol. 3, pt. 2, p. 686, pl. 43, fig. 25. (Upper Prosser *Fusispira* zone, near Cannon Falls, Minn.)

Valves medium in size, similar. Outline subelliptical to reniform; dorsal margin slightly concave, curving regularly into free margins; anterior and posterior margins rather sharply curved, ventral broadly so. Surface rising steeply from margins, particularly at valve ends; having rather large, rounded pits, those near the posterior being particularly conspicuous; anteroventral nonpunctate spot, the shell thickened and translucent. Contact not observed in paired valves, seems plane.

Holotype no. 41815 US. (Ulrich): length, 0.96 mm; width, 0.53 mm.

Uncommon in Guttenberg and Ion faunules. The species is narrower, more compressed than *P. rugosus*, and has relatively larger pits.

Genus PARASCHMIDTELLA Swartz, 1936

Genotype, *P. dorsopunctata* SWARTZ, *1936*, Jour. Paleontology, vol. 10, p. 563, pl. 86, figs. 1a–c. (Devonian, Shriver chert, Pennsylvania.)

Small, straight-hinged, elliptical to subquadrate Ostracoda, with broad thickened dorsal umbos, which generally project beyond the hinge, and thus modify the dorsal margin. Surface marked by deep, distinct, rounded punctae. Hingement and overlap not well known.—Swartz.

The species from the Decorah formation that are placed in the genus have small, translucent muscle spots, corresponding in some cases to internal partitions. *P. ovata* (Kay) and *P. centipunctata*, a new species, are similar in form to the genotype; *P. planilateralis*, new species, has a flat lateral surface, and lacks an umbo. *Primitia uphami* Ulrich (1894) may belong in the genus.

PARASCHMIDTELLA OVATA (Kay), 1934
Plate 30, figures 14–17

Punctaparchites ovatus KAY, *1934*, Jour. Paleontology, vol. 8, p. 332, pl. 44, fig. 5. (Lower Trenton Hull formation, Healey Falls, Ontario.)

The above description seems adequate, except that there is a small translucent muscle spot posterocentral on the valve. The species has some thirty to forty punctae.

One of the most common of Decorah species, found in both members of the formation.

PARASCHMIDTELLA CENTIPUNCTATA
Kay, n. sp.
Plate 30, figures 18–21

Valves small, similar. Outline suboval, tending to be dorsally and ventrally truncate; margins regularly curved, anterior most sharply; hinge straight, about two-thirds valve length; retral swing slight. Surface rising steeply from dorsal margin, which obscures hinge, regularly from free margins to dorsal umbo; surface having more than one hundred irregularly arranged pits, distributed over entire surface except on thickened, translucent subcentral muscle spot. Contact seems plane.

Holotype no. 27572 C. (Ion shale, 60 feet above McGregor limestone, six miles south of Cannon Falls, Minn.): length, 0.48 mm; width, 0.33 mm; thickness one valve 0.1 mm.

Abundant in the Ion at Cannon Falls; not found elsewhere.

PARASCHMIDTELLA PLANILATERALIS
Kay, n. sp.
Plate 30, figures 8–13

Valves small, similar. Outline oval, somewhat dorsally truncate; hinge about two-thirds valve length, centered posterior to midlength; margins regularly curved, ends similar; retral swing slight. Surface rising abruptly from margins to gently convex lateral surface; having about 30 distinct punctae irregularly arranged on lateral surface, absent on marginal border, which is slightly thickened; muscle spot indistinct, with corresponding internal ridge. Contact seems plane.

Holotype no. 27573 C. (Ion shale, 50 feet above McGregor limestone, near Ellsworth, Wis.): length, 0.52 mm; width, 0.32 mm; thickness one valve, 0.11 mm.

EXPLANATION OF PLATE 31

All figures approximately ×30

FIG. *1—Conchoprimitia tolli integra* Öpik, Kukruse formation, Kohtla Järve, Estonia. Lateral view of holotype. After Öpik (1937, pl. 9, fig. 1; as illustrated, original illustration reversed). (p. 249)

2, Eurychilina ventrosa Ulrich, upper part of Ion member, sec. 6, Glenwood Township, Iowa. Lateral view of hypotype 27628C, right valve. (p. 250)

3, 4—Eurychilina reticulata parvifrons Kay, n. var., Ion member, Ellsworth, Wis. Lateral view of right valve and ventral view of holotype 27577C, bivalved. (p. 250)

5—Eurychilina subradiata Ulrich, upper part of Ion member, sec. 13, Glenwood Township Winneshiek County, Iowa. Lateral view of hypotype 27629C, right valve (p. 250)

6–8—Eurychilina partifimbriata Kay, n. sp., Ion member, Cannon Falls, Minn. Dorsal view, lateral view of left valve, and ventral view of holotype 27578C, bivalved. (p. 251)

9—Eurychilina minutifoveata Kay, n. sp., middle part of Ion member, sec. 13, Glenwood Township, Winneshiek County, Iowa. Lateral view of holotype 27579C, right valve. (p. 251)

10—Apatochilina subaequata (Ulrich), Ion member, Cannon Falls, Minn. Lateral view of left valve of hypotype 27630C, bivalved. (p. 251)

11–15—Euprimitia sanctipauli (Ulrich), Ion member, *11, 12*, Lateral and posterior views of hypotype 27632C, female, left valve, Cannon Falls, Minn. *13, 14*, Lateral and ventral views of hypotype 27631C, male, right valve, middle part of member, sec. 13, Glenwood Township, Winneshiek County, Iowa. *15*, Lateral view of hypotype 27633C, female, left valve, sec. 13, Glenwood Township. (p. 252)

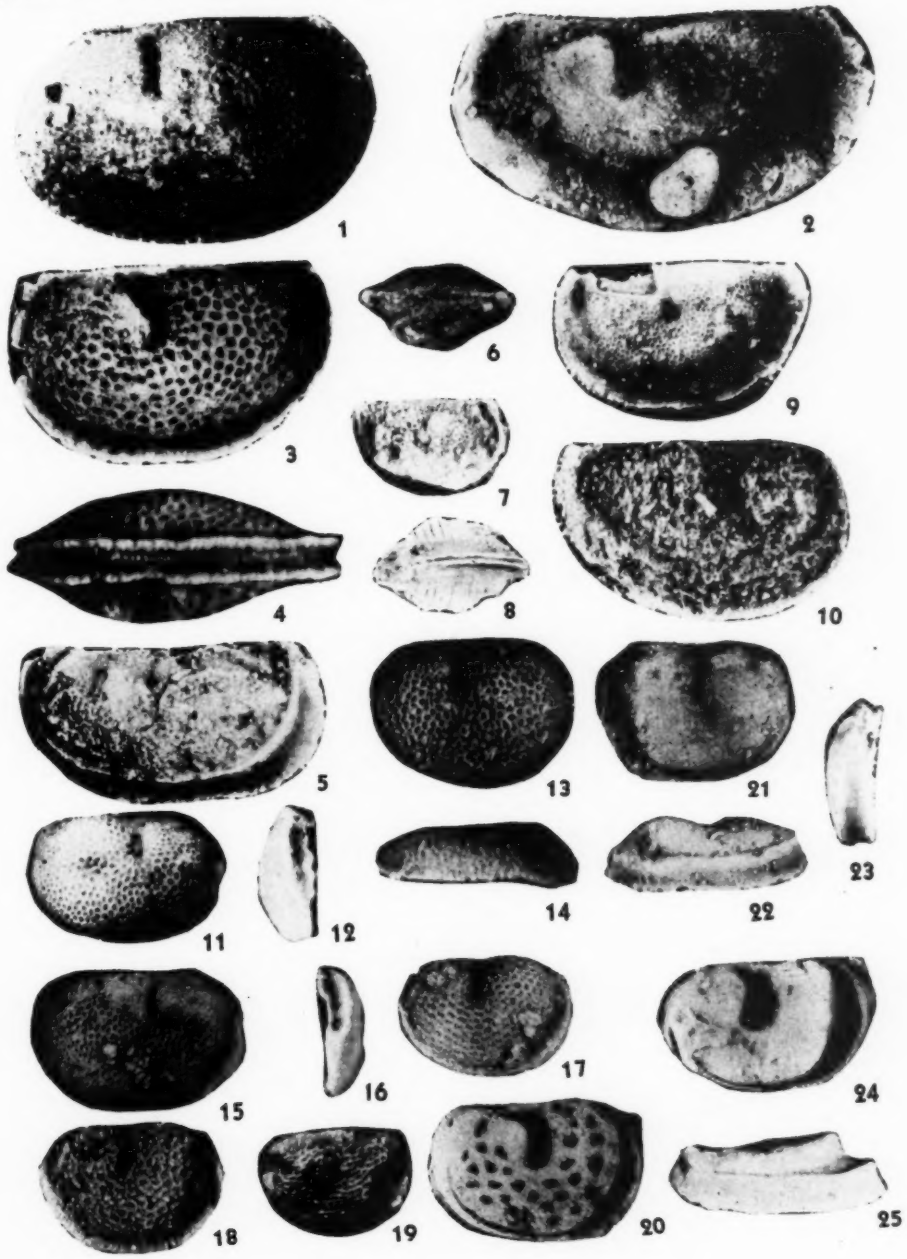
16–18—Euprimitia labiosa (Ulrich), lower part of Ion member, sec. 13, Glenwood Township, Iowa. *16, 17*, Posterior and lateral views of hypotype 27623C, female, right valve. *18*, Lateral view of hypotype 27634C, male, right valve. (p. 252)

19—Euprimitia linepunctata (Kay), lower part of Ion member, sec. 13, Glenwood Township, Iowa. Lateral view of hypotype 27635C, female, right valve. (p. 252)

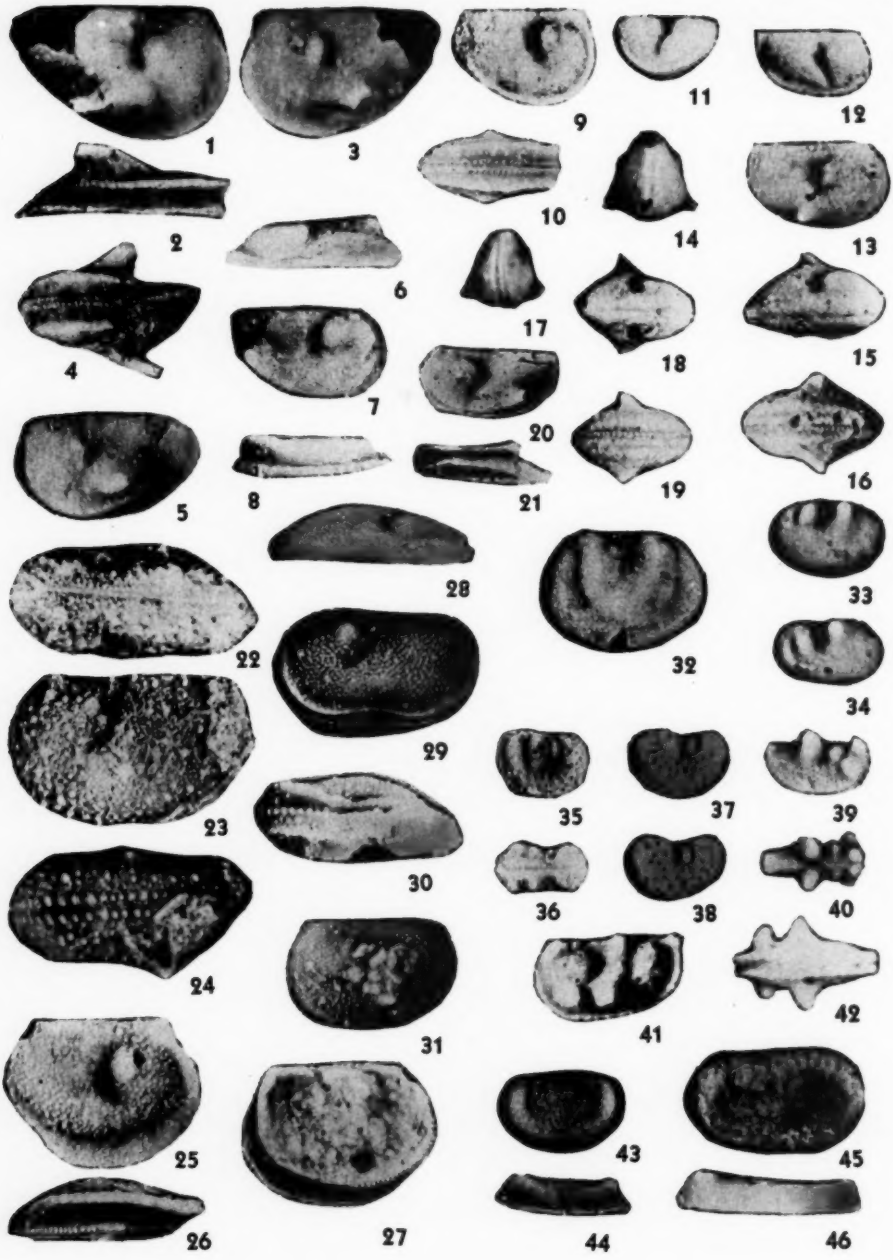
20—Halliella magnapuncta Kay, lower part of Ion member, sec. 13, Glenwood Township, Iowa. Lateral view of holotype 27481C, right valve. (p. 253)

21–23—Hallatia convexa Kay, n. sp., Guttenberg member, Church, Iowa. Lateral, ventral, and posterior views of holotype 27580C, left valve. (p. 253)

24, 25—Hallatia particylindrica Kay, upper part of Ion member, sec. 6, Glenwood Township, Iowa. Lateral and ventral views of holotype 27525C, right valve. (p. 253)



Kay, Ordovician (Decorah) Ostracoda



Kay, Ordovician (Decorah) Ostracoda

The species, abundant in the Ion member near Ellsworth, Wis., has not been recognized in other faunules. The species differs from *P. ovata* in its having a relatively flat lateral surface, and a subrectangular cross section.

Genus ERIDOCONCHA
Ulrich and Bassler, 1923

The genotype, *E. oboloides* Ulrich and Bassler, is a Decorah species, next described.

ERIDOCONCHA OBOLOIDES
Ulrich and Bassler, 1923
Plate 29, figures 34, 35

Eridonconcha oboloides ULRICH and BASSLER, *1923*, Maryland Geol. Survey, Silurian, p. 296, pl. 14, figs. 6–8. (Decorah shale, St. Paul, Minn.)

Valves small, similar. Outline elliptical with dorsal extension, somewhat trigonal; anterodorsal and posterodorsal margins linear, forming rounded obtuse angle dorsally; hinge short; free margins regularly curved, ventral broadly so. Surface quite convex, rising gently from free margins to dorsal umbo; having several arcuate belts defined by centrally facing low shoulders, usually three to five, giving the valve the aspect of a pelecypod having prominent growth lines; umbonal surface varying in size, frequently having small apical sulcus. Contact seems plane.

Hypotype no. 27575 C. (Ion shale, 60 feet above McGregor limestone, six miles south of Cannon Falls, Minn.): length, 0.80 mm; width, 0.67 mm; thickness, 0.25 mm.

EXPLANATION OF PLATE 32

All figures approximately ×30

FIGS. *1–5—Winchellatia longispina* Kay, n. sp., upper part of Guttenberg member, sec. 13, Glenwood Township, Iowa. *1, 2*, Lateral and ventral views of holotype 27586C, female, left valve. *3*, Lateral view of paratype 27636C, female, right valve. *4, 5*, Ventral view and lateral view of right valve of paratype 27637C, male, bivalved. (p. 254)

6–8—Winchellatia langsingensis Kay, n. sp., lower part of Guttenberg, Church, Iowa. Dorsal, lateral, and ventral views of holotype 27587C, left valve. (p. 254)

9–11—Winchellatia initialis (Ulrich), Ion member, Cannon Falls, Minn. *9, 10*, Lateral view of left valve and ventral view of hypotype 27638C, bivalved. *11*, Lateral view of right valve of hypotype 27639C, bivalved. (p. 254)

12—Winchellatia variolaris (Bonnema), Kuckerschiefe, Estonia. Lateral view of paratype, female, left valve, after Bonnema (1909, pl. 5, fig. 11). (p. 254)

13–19—Winchellatia minnesotensis Kay, n. sp., Ion member, Cannon Falls, Minn. *13–16*, Lateral view of left valve, anterior, dorsal, and ventral views of holotype 27598C, bivalved. *17–19*, Dorsal, ventral, and anterior views of paratype 27640C, bivalved. (p. 255)

20, 21—Winchellatia kuckersiana (Bonnema), Kuckerschiefe, Estonia. Lateral and ventral views of paratype, female, right valve. (p. 254)

22–24—Parabolbina antecedens Kay, n. sp., Ion member, Cannon Falls, Minn. Dorsal view, lateral view of right valve, and ventral view of holotype 27583C, bivalved. (p. 255)

25–27—Parabolbina staufferi Kay, n. sp., Ion member, Cannon Falls, Minn. Lateral, ventral, and interior views of holotype 27585C, female, left valve. (p. 256)

28–31—Parabolbina carinifera Kay, n. sp., *28–30*, Dorsal view, lateral view of right valve, and ventral views of holotype 27584C, male, bivalved, slightly crushed, Ion member, sec. 6, Glenwood Township, Iowa. *31*, Lateral view of paratype 27614C, male, left valve, middle part of Ion member, sec. 13, Glenwood Township, Iowa. (p. 255)

32—Bollia subaequata Ulrich, upper part of Ion member, Church, Iowa. Lateral view of hypotype 27648C, left valve. (p. 258)

33, 34—Bollia simplex (Ulrich), lower part of Ion member, Ion, Allamakee County, Iowa. *33*, Lateral view of hypotype 27649C, left valve. *34*, Lateral view of hypotype 27650C, left valve. (p. 258)

35, 36—Maratia mara Kay, n. sp., Sherman Fall formation, near Gamebridge, Victoria County, Ontario. Lateral view of left valve and dorsal view of holotype 27590C, bivalved. (p. 258)

37, 38—Maratia micula (Ulrich), lower part of Ion member, Church, Iowa. *37*, Lateral view of hypotype 27651C, left valve. *38*, Lateral view of hypotype 27652C, left valve. (p. 259)

39, 40—Kiesowia verrucosa Kay, n. sp., Ion member, Cannon Falls, Minn. Lateral view of left valve and dorsal view of holotype 27588C, bivalved. (p. 260)

41, 42—Kiesowia pernodosa Öpik, Uhaku formation, Tallinn, Estonia. Lateral view of right valve and ventral view of holotype, after Öpik (1937, pl. 14, figs. 3, 2). (p. 260)

43, 44—Parenthatia punctata (Ulrich), middle part of Ion member, sec. 6, Glenwood Township, Iowa. Lateral and ventral views of holotype 27589C, right valve. (p. 259)

45, 46—Parenthatia camerata Kay, n. sp., upper part of Ion member, sec. 6, Glenwood Township, Iowa. Lateral and ventral views of holotype 27589C, right valve. (p. 259)

This is a common species in both members of the Decorah formation at many localities.

Family PRIMITIIDAE
Ulrich and Bassler, 1923

Primitiidae ULRICH and BASSLER, *1923*, Maryland Geol. Survey, Silurian, p. 297;—SWARTZ, *1936*, Jour. Paleontology, vol. 10, p. 549.

Subfamily PRIMITIINAE
(Ulrich and Bassler), 1923

Genus PRIMITIA Jones and Holl, 1865

Genotype, *Beyrichia mundula* JONES, *1855*, Annals and Mag. Nat. History, vol. 16, no. 2, p. 90, pl. 5, fig. 23 (Silurian, Germany). *Primitia mundula* JONES and HOLL, *1865*, Annals and Mag. Nat. History, vol. 16, no. 3, p. 416;—SWARTZ, *1936*, Jour. Paleontology, vol. 10, p. 565, pl. 86, figs. 4a–c.

A single species in the Decorah fauna, *Primitia mammata* Ulrich, seems to conform quite closely to the genotype.

PRIMITIA MAMMATA Ulrich, 1894
Plate 30, figure 22

Primitia mammata ULRICH, *1894*, Geology Minnesota, vol. 3, pt. 2, p. 652, pl. 43, figs. 78, 79, 81. ("Lower third of Trenton shales"—probably Guttenberg member, Decorah formation, Minneapolis, Minn.)

Valves small, similar. Outline suboval; hinge little more than half valve length, centered posteriorly, obscured except terminally by dorsal margin, which is convex; free margins regularly curved, ends similar; retral swing slight. Surface rising steeply from dorsal margin, gently from free margins to greatest thickness in centrodorsal; having a dorsally extending, well-defined but frequently faint sulcus posterior to midlength, margined by poorly defined swellings; shell thickened and translucent in sulcus; surface smooth. Contact seems plane.

Holotype no. 41349 US. (Ulrich): length, 0.51 mm; width, 0.30 mm; thickness one valve, 0.18 mm.

The species is one of the most common forms in faunules from the Guttenberg and Ion members.

Genus LACCOPRIMITIA
Ulrich and Bassler, 1923

Genotype *Primitia centralis* ULRICH, *1890*, Cincinnati Soc. Nat. History, vol. 13, p. 130, pl. 10, figs. 1, 2a–c. ("Utica shales," Cincinnati, Ohio.)

The genus is characterized by having a shallow pit posterior to the valve center. There is a single Decorah species.

LACCOPRIMITIA FILLMORENSIS
(Ulrich), 1894
Plate 30, figures 23–26

Primitiella fillmorensis ULRICH, *1894*, Geology Minnesota, vol. 3, pt. 2, p. 649, pl. 45, figs. 26–30. ("Lower Trenton shales"—Guttenberg member, Decorah formation, Fountain, Minn.)

Valves small, similar. Outline subcircular to short subelliptical, dorsally truncated; hinge short, straight; free margins regularly curved, joining dorsal margin in regular curve anteriorly, with slight angle posteriorly; ends similar, anterior the more sharply curved. Surface rising rather gently from margins, most steeply at posterior, having shallow anteriorly concave sulcus dorsal and little posterior to valve center, continuing dorsally as broad, shallow depression; surface not well preserved, but seems finely granulate. Contact not observed in paired valves, seems plane, bordered by very shallow channel in some specimens.

Holotype no. 41476 US. (Ulrich): length, 0.55 mm; width, 0.38 mm; thickness, 0.20 mm.

Locally common in Ion member at several localities; not found in Guttenberg in Iowa, though type came from this member in Minnesota.

Genus HAPLOPRIMITIA
Ulrich and Bassler, 1923

Haploprimitia ULRICH and BASSLER, *1923*, Maryland Geol. Survey, Silurian, p. 297.

Genotype *Primitia minutissima* ULRICH, *1894*, Geology Minnesota, vol. 3, pt. 2, p. 651, pl. 45, fig. 31. ("Lower part of Trenton shales"—Guttenberg member, Decorah formation, Fountain, Minn.) It has not been recognized in the later collections.

Genus CONCHOPRIMITIA Öpik, 1937

Genotype (here designated) *Conchoprimitia tallinensis* ÖPIK, *1937*, Nat. Soc. Tartu Univ. Annals, vol. 43, p. 11, pl. 9, figs, 3a–c (Uhaku formation, Estonia).

The valves of the holotype are medium in size, similar. Outline truncate elliptical, hinge moderately long. Surface rather regu-

larly convex, having distinct sulcus posterodorsal to center; central surface separated from border by low shelving margin; central part of valve coarsely pitted. Left valve bearing groove, slightly larger than right (the orientation being reversed in the original description).

The species *Eurychilina (?) symmetrica* Ulrich in the Decorah fauna is most similar to *C. tolli* (Bonnema), a species in which a groove, most conspicuously developed anteriorly, defines the central area. This Decorah species seems dimorphic, bearing a broad marginal flange in some specimens.

CONCHOPRIMITIA SYMMETRICA
(Ulrich), 1894
Plate 30, figures 28–32

Eurychilina? symmetrica ULRICH, *1894*, Geology Minnesota, vol. 3, pt. 2, p. 663, pl. 44, figs. 5–7; pl. 45, figs. 4–6. ("Upper third of Trenton shales"—Ion member, Decorah formation, Cannon Falls, Minn.)

Valves rather large, similar. Outline subelliptical; hinge straight, quite long; dorsal margin slightly sinuous, meeting ends in obtuse angles; free margins regularly curved, anterior most sharply; ends subequal. Dimorphic, female form bearing flange within free margins. Male form rather regularly convex, depressed anterodorsally; shallow depression separating rather broad, terminally narrowing, slightly convex border within free margins from central area of valve; depression conspicuous within cardinal extremities; central area bearing shallow sulcus dorsal and somewhat posterior to center, with corresponding strong ridge in interior of valve; adjoining surface broadly convex; commonly smooth, but in some specimens with coarse punctae, tending to be best developed in posteroventral of central area and adjoining border. Contact having tongue and groove in opposing valves, not consistent as to valve. Female dimorph having broader border within free margins; central area somewhat variable, normally with shallow sulcus bordered by swollen lobes joined within dorsal margin by low ridge, depressed dorsal to sulcus; bearing pits in some specimens, those on border being elongate parallel to margin. Margin extending considerably beyond contact, particularly along posterior and ventral, of varying breadth; it should be emphasized that the interiorly concave flange lies beneath the outer part of the convex border, the concentric exterior depression being well within the contact.

Holotype no. 41386 US. (Ulrich): length, 1.80 mm; width, 1.10 mm; thickness, 0.4 mm (female valve).

Abundant in Ion member at Cannon Falls, Minn. and Ellsworth, Wis.; frequent in Iowa; not found in Guttenberg member.

The species is placed with confidence in the genus *Conchoprimitia*, and resembles *C. tolli* (Bonnema), in which the sulcus is relatively a little farther posterior; the ornamentation is similar, but female dimorphs have not been described for the Estonian species. The species may also be congeneric with *Coelochilina aequata* (Ulrich), a genotype, in which case the genera are synonyms, the name *Coelochilina* Ulrich and Bassler, 1923, having precedence. The latter genus has a very convex intramarginal border, and resembles the male form of *Conchoprimitia*

Subfamily EURYCHILININAE
Ulrich and Bassler, 1923

Eurychilininae ULRICH and BASSLER, *1923*, Maryland Geol. Survey, Silurian, p. 302.

Genus EURYCHILINA Ulrich, 1889

Genotype, *Eurychilina reticulata* ULRICH, *1889*, Canada Geol. Survey, Contr. Micro-Pal., pt. 2, p. 52, pl. 9, figs. 9, 9a. ("Lower third of Trenton shales"—Guttenberg member, Decorah formation, Fountain, Minn.)

Valves medium in size, similar. Outline in simple form truncate subelliptical. Surface rather regularly convex, with distinct sulcus posterodorsal to midvalve, with rounded node to posterior; some forms having broad, striate frill of varying character; surface coarsely reticulate or pitted, or smooth. Contact seems simple.

There are several species in the Decorah fauna that are referable to this genus with varying certainty. *E. reticulata*, the genotype, has a distinct sulcus, a laterally extending marginal frill, and is coarsely pitted; the forms *E. reticulata parvifrons*, n. subsp., and *E. reticulata incurva* Ulrich differ from the type only in the character of the frill, the former having only a narrow marginal flange, the latter a laterally con-

vex flange. *E. ventrosa* Ulrich resembles *E. incurva*, but is smooth. *E. subradiata* Ulrich conforms to the genotype in its general characters, differing in the structure of the flange and in having fewer punctae; it is in itself dimorphic. The new species *E. partifimbriata* differs considerably; though bearing a striate frill and fine punctae, it lacks the distinct sulcus that characterizes the more typical species; in this latter respect, it resembles *Apatochilina*.

EURYCHILINA RETICULATA Ulrich, 1889

Eurychilina reticulata ULRICH, *1889*, Canada Geol. Survey, Contr. Micro-Pal., pt. 2, p. 52, pl. 9, figs. 9, 9a. ("Lower third of Trenton shales"—Guttenberg member, Decorah formation, Fountain, Minn.);—ULRICH, *1894*, Geology Minnesota, vol. 3, pt. 2, p. 660, pl. 44, fig. 1.

Eurychilina reticulata incurva ULRICH, *1894*, Geology Minnesota, vol. 3, pt. 2, p. 661, pl. 44, fig. 2. ("Upper third of Trenton shales"—Ion member, Decorah formation, St. Paul, Minn.)

Holotype of *E. reticulata*, no. 41601 US. (Ulrich): length, 2.40 mm; width, 1.3 mm; thickness, one valve, 0.50 mm.

EURYCHILINA RETICULATA PARVIFRONS KAY, n. var.
Plate 31, figures 3, 4

There are three forms in the Decorah faunules that are centrally like *E. reticulata*, but that differ in the characters of their marginal frills; their interrelations are not clear, and they are considered as subspecies, though they are probably forms of a single species.

Valves medium in size, similar. Trimorphic, simplest form (*E. reticulata parvifrons* Kay) truncate subelliptical; hinge straight; joining terminal margins in rounded obtuse angle; free margins regularly curved, bearing narrow, laterally concave, striate border flange; surface within rising gently to center of valve; well-defined posteriorly, concave sulcus posterodorsal to valve center, partially inclosing small, smooth node; surface coarsely reticulately pitted, pits polygonal in outline, narrowly separated. Contact seems simple, bordered by channel, obscured by marginal flange.

Form *E. reticulata sensu stricto* bearing a broad, laterally concave, marginally serrate, striate frill on free margins; form *E. reticulata incurva* bearing a somewhat narrower, laterally convex striate frill, covering an interior intramarginal pouchlike trough.

Holotype of *E. reticulata parvifrons*, no. 27577 C. (Ion shale, 50 feet above McGregor limestone, west of Ellsworth, Wis.): length, 1.68 mm; width, 1.02 mm; thickness, 0.68 mm.

Frequent in Guttenberg and Ion members at many localities but rarely well preserved.

EURYCHILINA VENTROSA Ulrich, 1894
Plate 31, figure 2

Eurychilina ventrosa ULRICH, *1894*, Geology Minnesota, vol. 3, pt. 2, p. 662, pl. 45, figs. 1–30. (Base of *Fusispira* zone, Prosser formation, Cannon Falls, Minn.)

This species has been described and illustrated quite adequately by Ulrich. The species is very similar to *E. reticulata incurva*, but is smooth. The convex border corresponds to an internal channel that seems to be a brood pouch. Though no dimorphs that are definitely of this species have been found, a relatively small similar form lacking the marginal frill is represented.

Holotype no. 41625 US. (Ulrich): length, 2.40 mm; width, 1.5 mm.

Frequent in the Ion member in northeastern Iowa; the types, from high in the Prosser formation, do not differ markedly.

EURYCHILINA SUBRADIATA Ulrich, 1890
Plate 31, figure 5

Eurychilina subradiata ULRICH, *1890*, Cincinnati Soc. Nat. History, Jour., vol. 13, p. 126, pl. 9, figs. 1, 2. (Black River, Lebanon, Tennessee);—ULRICH, *1894*, Geology Minnesota, vol. 3, pt. 2, p. 661, pl. 44, figs. 3, 4.

The species differs centrally from *E. reticulata* in that it is punctate, the punctae being subcircular, smaller than the pits in *E. reticulata*, and more abundant than is suggested in Ulrich's illustration. The margin differs considerably, and the Decorah specimens from Iowa do not conform exactly to Ulrich's description. In one dimorph, the central convex part of the valve is margined by a channel, which is bordered by a second broader channel, defined by narrow ridges; the appearance is as in Ulrich, 1894, pl. 44, fig. 4, but there is no evidence of

the internal partition shown in fig. 4a. The other dimorph has an additional interiorly concave striate frill, the inner margin of which lies beneath the border channel of the first form. Thus, forms like that in fig. 4 seem to be male forms, and female forms, similar to fig. 4a, have the inner partition beneath the marginal channel of the male form, a narrow ridge on the crest of the frill, and a continuing extension peripherally.

Uncommon in Ion member, Decorah formation, at a few localities in northeastern Iowa; type from the Black River of Tennessee; and the species is reported in the Guttenberg member of Minnesota.

EURYCHILINA PARTIFIMBRIATA
Kay, n. sp.
Plate 31, figures 6–8

Valves small, similar. Outline truncate oval; hinge straight, long; dorsal margin slightly convex, joining anterior margin in right angle, posterior with slightly obtuse angle; free margins regularly curved; retral swing obvious. Valves quite thick, rising steeply from thickened border to frill on free margins, more gently from dorsal; central surface rather regularly convex, greatest thickness being at inconspicuous node a little posterodorsal to center; shallow, poorly defined sulcus anterior to node; flange, a narrow ridge near anterodorsal, becomes abroad, laterally and slightly dorsally extending striate frill along venter, narrows posteriorly. Surface within frill finely pitted. Contact simple, with thickened border.

Holotype no. 27578 C. (Ion shale, 60 feet above McGregor limestone, near Cannon Falls, Minn.): length, 0.70 mm; width, 0.41 mm; thickness, 0.35 mm; thickness through frill, 0.48 mm.

A single entire specimen has been found. The small size, pitted ornamentation and anteriorly narrowing, laterally trending frill makes the species distinctive.

EURYCHILINA MINUTIFOVEATA
Kay, n. sp.
Plate 31, figure 9

Valves medium in size, similar. Outline truncate-subelliptical; hinge straight, long; dorsal margin meeting ends in rounded obtuse angles; free margins regularly curved, ends subequal. Surface having narrow flat border on free margins, broader and flaring on anterior; central area gently convex; distinct sulcus posterodorsal to midvalve, with posterior border somewhat higher than anterior, but without distinct node; surface with very fine reticulate pits, those on the border linear, parallel to margin. Contact seems simple, with granules bordering it obscured laterally by narrow flange.

Holotype no. 27579 C. (Ion member, sec. 12, Glenwood Township, Winneshiek County, Iowa): length, 1.31 mm; width, 0.80 mm; thickness one valve, 0.28 mm.

Uncommon in Ion member at locality of holotype; not found elsewhere. The species resembles *Apatochilina subaequata* but is finely pitted rather than granular, the ornamentation being like that characteristic of the genus *Eurychilina*.

Genus APATOCHILINA
Ulrich and Bassler, 1923

Genotype *Eurychilina obesa* ULRICH, *1890*, Cincinnati Soc. Nat. History, Jour., vol. 13, p. 129, pl. 9, fig. 13. (Black River limestone, High Bridge, Kentucky.) *Apatochilina obesa* ULRICH and BASSLER, *1923*, Maryland Geol. Survey, Silurian, p. 304.

APATOCHILINA SUBAEQUATA (Ulrich)
Kay, n. comb.
Plate 31, figure 10

Eurychilina? subaequata ULRICH, *1894*, Geology Minnesota, vol. 3, pt. 2, p. 663, pl. 45, figs. 7–9. (*"Phylloporina"—Chasmatopora* bed, Ion member, Decorah formation, St. Paul, Minn.)

The species is well described by Ulrich. A single specimen in the present collection has a relatively narrower border than the type.

Holotype no. 41628 US. (Ulrich): length, 1.55 mm; width, 0.85 mm; thickness one valve, 0.58 mm.

Rare in Ion member near Cannon Falls, Minn. The species is placed by Ulrich and Bassler in the genus *Coelochilina*, though the original description states that it "agrees very well in most respects" to *Eurychilina? obesa*, genotype of *Apatochilina*, "but may be distinguished by the absence of any well-defined sulcus" in that species. The principal distinguishing features of *A. obesa* seem to be its lacking a node, and having granular ornamentation.

Genus EUPRIMITIA
Ulrich and Bassler, 1923

Genotype *Primitia sanctipauli* ULRICH, *1894*, Geology Minnesota, vol. 3, pt. 2, p. 652, pl. 43, figs. 73, 74. ("Upper Trenton shales"—Ion member, Decorah formation, St. Paul, Minn.) *Euprimitia sanctipauli* ULRICH and BASSLER, *1923*, Maryland Geol. Survey, Silurian, p. 299; text fig. 15, no. 5.

The presence of dimorphism in the genus has not been previously reported. *Euprimitia* includes species having a distinct posterodorsal sulcus in front of a rounded node, pitted ornamentation, and, in female valves, a posteroventral flange obscuring a marginal, channellike pouch; male valves have a depressed posteroventral border.

E. sanctipauli (Ulrich) and *E. labiosa* (Ulrich) are represented by specimens of both forms; the similar *E. linepunctata* (Kay) has been collected only in female forms. The genus is similar in character of sulcus and node to *Halliella* and *Hallatia*, the former having coarse punctation, the latter being smooth; neither exhibits dimorphism in the specimens studied. *Primitia celata* Ulrich, 1894, may be congeneric.

The new genus *Bolbiprimitia*, genotype *Halliella fissurella* Ulrich and Bassler, 1923, Maryland Geol. Survey, Silurian, p. 514, pl. 37, figs. 22, 23 (Silurian Tonoloway limestone, Keyser, West Virginia) is distinguished from *Euprimitia* in having, in the female dimorph, a ventral elliptical brood pouch.

EUPRIMITIA SANCTIPAULI (Ulrich), 1894
Plate 31, figures 11–15

Primitia sanctipauli ULRICH, 1894, Geology Minnesota, vol. 3, pt. 2, p. 652, pl. 43, figs. 73, 74. (Ion member, Decorah formation, St. Paul, Minn.)

Valves medium in size, similar. Outline truncate subelliptical; hinge straight, rather short; dorsal margin curving regularly into free margins; free margins regularly curved; retral swing evident. Dimorphic surface in male form rising gently from dorsal margin, and from free margins; greatest thickness anterior to center; well-defined sulcus posterior to midvalve in dorsal half of valve, concave posteriorly; bordered on posterior by distinct, poorly defined node; female valve leaving flaring posteroventral flange, obscuring channelled posteroventral border, channel narrowing and disappearing midventrally; surface reticulately pitted except within sulcus. Contact not seen in paired valves, seems plane.

Holotype no. 41343 US. (Ulrich): length, 0.86 mm; width, 0.56 mm; thickness one valve, 0.38 mm.

Uncommon to rare at a few localities in Iowa and Minnesota in the Ion member.

EUPRIMITIA LABIOSA (Ulrich)
Kay, n. comb.
Plate 31, figures 16–18

Halliella labiosa ULRICH, *1894*, Geology Minnesota, vol. 3, pt. 2, p. 656, pl. 46, figs. 43–46. (*Nematopora* bed, lower Prosser formation, Goodhue County, Minn.).—KAY, *1934*, Jour. Paleontology, vol. 8, p. 332, pl. 44, figs. 17, 18.

Kay's description (1934) is of the female dimorphs, though the illustrations are of male valves; and the orientation of the valves is reversed. The male valve is rather regularly convex, with a thickened, smooth, abruptly rising border, narrowly channeled, but lacking the posteroventral flare and bordering channeled brood pouch of the female form.

The species is uncommon in the Guttenberg and Ion members at several localities in Iowa; it is frequent in the Hull formation in Ontario. The ornamentation is more similar to that in *Euprimitia* than in *Halliella*.

EUPRIMITIA LINEPUNCTATA (Kay)
Kay, n. comb.
Plate 31, figure 19

Halliella linepunctata KAY, *1934*, Jour. Paleontology, vol. 8, p. 335, pl. 44, figs. 19–21. (Upper Ion member, Decorah formation, Winneshiek County, Iowa.)

The orientation in the original description is reversed, and the described valves are females. A few of the specimens have relatively narrow channeled borders, rising less abruptly than in the female form, thus not obscuring the contact, and lack the posteroventral projection.

This is a frequent to common species in the Guttenberg and Ion members at most localities. The species differs from *E. labiosa* in the linear arrangement of the punctae; a persistent feature is an anteroventral, intra-

marginal furrow that continues as a narrow groove within the ventral border.

Genus HALLIELLA Ulrich, 1894

Genotype, (designated by Bassler, 1915) *Primitia? sculptilis* ULRICH, *1890*, Cincinnati Soc. Nat. History, Jour., vol. 13, p. 136, pl. 8, fig. 6. (Trenton, Perryville formation, Perryville, Ky.) *Halliella sculptilis* ULRICH, *1890*, Cincinnati Soc. Nat. History, Jour., vol. 13, p. 184.

The genus is now restricted to species having a coarsely pitted surface like that of the genotype. *Halliella magnapuncta* Kay is the only representative in the Decorah fauna.

HALLIELLA MAGNAPUNCTA Kay, 1934
Plate 31, figure 20

Halliella magnapuncta KAY, 1934, Jour. Paleontology, vol. 8, p. 334, pl. 45, figs. 1, 2. (Lower Ion member, Decorah formation, Winneshiek County, Iowa.)

The original description is adequate. No evidence of dimorphism has been seen in the specimens.

Frequent in the Guttenberg member, rare in the Ion member of the Decorah formation in northeastern Iowa; rare in the lower Hull shales of Ontario.

Genus HALLATIA Kay, 1934

Genotype *Hallatia healeyensis* KAY, *1934*, Jour. Paleontology, vol. 8, p. 335, pl. 45, figs. 5, 6. (Lower Trenton Hull formation, Healey Falls, Ontario.)

In addition to the previously described *H. particylindrica* the Decorah faunules contain *H. convexa*, n. sp. *Primitia duplicata* Ulrich, not represented in the present collections, may also belong in the genus.

HALLATIA CONVEXA Kay, n. sp.
Plate 31, figures 21–23

Valves small, similar. Outline dorsally truncate elliptical; dorsal margin linear to slightly convex; hinge straight, fairly long, with small cardinal area; free margins regularly curved, posterior more sharply than anterior; slight retral swing. Surface of valves rising steeply from all margins, having narrow intramarginal groove within venter, becoming rounded steep toward anterior; sharply defined median sulcus, posteriorly concave, extending dorsally to margin, having elevated broad node to posterior; area anterior to sulcus rather regularly convex; surface smooth. Contact seems plane, with slightly concave, abruptly rising border on free margins.

Holotype no. 27580 C. (Guttenberg member, Decorah formation, Church, Iowa): length, 0.87 mm; width, 0.60 mm; thickness one valve, 0.22 mm.

Frequent in Guttenberg and Ion faunules from several localities in Iowa. The species differs from the similar *H. particylindrica* in the generally convex character of the central surface, which is slightly concave and abruptly terminated anteriorly in that species.

HALLATIA PARTICYLINDRICA Kay, 1934
Plate 31, figures 24, 25

Hallatia particylindrica KAY, *1934*, Jour. Paleontology, vol. 8, p. 336, pl. 45, figs. 3, 4. (Ion member, Decorah formation, Winneshiek County, Iowa.)

The original description is adequate.

Rare in the Ion member in Winneshiek County, Iowa, only four specimens having been found. The distinction from *H. convexa* is discussed under that species.

HALLATIA? DUPLICATA (Ulrich), n. comb.

Primitia duplicata ULRICH, *1894*, Geology Minnesota, vol. 3, pt. 2, p. 654, pl. 43, figs. 60, 61. ("Middle third of Trenton shales"—Guttenberg member, Decorah formation, Minneapolis, Minn.)

This species is not represented in the collections. From the description, it seems to resemble *H. convexa*, but differs in having a flaring flange within the posterior border, which extends to the venter and continues anteriorly as a false border obscuring the contact.

Genus WINCHELLATIA Kay, n. gen.

Genotype, *W. longispina* Kay, n. sp. (Guttenberg member, Church, Iowa.)

Valves medium in size, similar. Outline truncate oval; hinge straight, quite long. Valves irregularly convex, bearing distinct posteriorly concave sulcus posterior to valve center, extending to dorsal margin; margined by rounded node on posterior lobe; dimorphic, posteroventral margin in female form bearing flange, typically stri-

ate; surface smooth, having nodes or spines on anterior lobe. Contact seems plane.

The genus resembles *Hallatia* in the character of the sulcus and lobation, being distinguished by its bearing anteroventral spines or ridges. In *Acronotella* Ulrich and Bassler, the sulcus is oblique and approaches the posteroventral margin; the genus has a ventral spine. The Decorah fauna contains, in addition to the genotype, *Beyrichia initialis* Ulrich and the new species *W. lansingensis*. The Baltic species *Entomis obliqua* Krause, *E. variolaris* Bonnema (pl. 32, fig. 12) and *E. obliqua kuckersiana* Bonnema (pl. 32, figs. 20, 21) seem congeneric.

WINCHELLATIA LONGISPINA Kay, n. sp.
Plate 32, figures 1–5

Valves small, similar. Outline dorsally truncate oval; hinge straight, quite long; dorsal margin straight, joining anterior in broad curve, posterior with obtuse angle; free margins regularly curved, anterior more sharply; retral swing apparent. Dimorphic, surface of male valve rising gently from dorsal and anterior margins, steeply from ventral and posterior; bearing distinct sulcus posterior to center, posteriorly concave, with small node behind it; sulcus extending dorsally into posteriorly broadening depression dorsal to node; anterior part of valve broadly convex, rising to center of posterior half of valve, from which extends anteroventrally a long spine, incomplete in collected specimens, but extending beyond margin. Contact seems simple, bordered by row of small granules. Female dimorphs bearing arcuate, slightly striate frill, forming posterior and ventral margins becoming intramarginal anteroventrally and terminating; obscuring a channel bordering the contact.

Holotype no. 27586 (upper Guttenberg member, Church, Iowa): length, incomplete, 0.95 mm; width, 0.57 mm; thickness to base of spine, one valve, 0.22 mm (female dimorph).

Common in Guttenberg member of the Decorah formation, particularly at Church, Iowa; specimens commonly fragmentary.

WINCHELLATIA INITIALIS (Ulrich)
Plate 32, figures 9–11

Beyrichia initialis ULRICH, *1894*, Geology Minnesota, vol. 3, pt. 2, p. 658, pl. 43, figs. 82, 83. ("Middle third of Trenton shales"—Guttenberg member, Decorah formation, Minneapolis, Minn.)

Valves small, similar. Outline truncate elliptical; hinge straight, quite long; free margins regularly curved, anterior most sharply; retral swing slight. Not known to be dimorphic; surface rising abruptly from margin to an intramarginal, laterally projecting, narrow flange within free margins except at anterior; separated from gently convex surface within by shallow depression; distinct posteriorly concave sulcus slightly posterior to center, partially enclosing rounded node; posterior and anterior lobes joining ventrally, having short spine or node in midventral, the thickest point on the valve. Contact simple, with slightly thickened border bearing a row of small granules.

Holotype no. 41666 US. (Ulrich): length, 0.65 mm; width, 0.41 mm; thickness, one valve, 0.30 mm.

Uncommon in Ion shale, south of Cannon Falls, Minn.; single specimen found in Guttenberg member in Iowa.

WINCHELLATIA LANSINGENSIS
Kay, n. sp
Plate 32, figures 6–8

Valves small, similar. Outline truncate elliptical; hinge straight, quite long; dorsal margin straight, meeting anterior margin at right angles, posterior in rounded obtuse angle; free margins regularly curved; retral swing obvious. Surface rising steeply from marginal flange, to relatively flat lateral surface; having distinct posteriorly concave sulcus posterior to center, in front of oval node posterodorsal to center; anteroventral surface extending anterodorsally within margin as abruptly terminated ridge; anterodorsal surface relatively depressed; surface seems smooth. Contact plane, bordered by a narrow flange on free margins.

Holotype no. 27587 C. (Lower Guttenberg member, Church, Iowa): length, 0.70 mm; width, 0.40 mm; thickness one valve, 0.18 mm.

Abundant in the Guttenberg member in northeastern, and not found in the Ion member. The species has a similar sulcus and node to the genotype, but no dimorphism was detected in the many specimens examined. The species is most similar to

Entomis kuckersiana Bonnema (pl. 32, figs. 20, 21), which has a more laterally projecting spinose ridge within the anteroventral margin, and is dimorphic, the female form having a ventral marginal channel. *Primitiella? ventricosa* Swartz, placed in the genus *Kirkbyella* by Warthin (1937, p. 84), has a broader anteroventral ridge, and marginal spines; the surface may be granulose.

WINCHELLATIA MINNESOTENSIS
Kay, n. sp.
Plate 32, figures 13–19

Valves small, similar. Outline truncate elliptical; hinge straight, quite long; dorsal margin straight, meeting anterior margin in slightly obtuse angle, posterior more broadly; free margins regularly curved; retral swing obvious. Surface quite convex, rising steeply from margins; having distinct posteriorly concave median sulcus, with distinct node to posterior; midventral ventroanteriorly projecting short spine, giving bivalved carapace subequilateral triangular section; surface smooth. Contact seems plane, with thickened border, margined by narrow channel; row of small granular nodes along ventral margin.

Holotype no. 27598 C. (Ion member, 55 feet above McGregor limestone, six miles south of Cannon Falls, Minn.): length, 0.73 mm; width, 0.43 mm; thickness 0.52 mm.

Uncommon in Ion member near Cannon Falls, Minn. The species differs from *W. initialis* (Ulrich) in its bearing a distinct anteroventrally extending spine in the position of a low node on that species, and in lacking the abruptly rising marginal flange. The spine is very short in contrast to that in *W. longispina* Kay.

Genus PARABOLBINA Swartz, 1936

Genotype, *Ctenobolbina granosa* ULRICH, *1900*, Cincinnati Soc. Nat. History, Jour., vol. 19, f. 183, pl. 8, fig. 12. (Devonian-Helderbergian, New Scotland limestone, New York.)

The genus is most similar to *Ctenobolbina* Ulrich. It differs in being unisulcate, and typically bearing a somewhat crenulate posteroventral flange. The two genera were placed in the family Hollinidae by Swartz; to the writer, they seem more properly to belong in the Primitiidae, though they may be intermediate between the two families. They are primitiids having a granular surface ornamentation and bearing a posteroventral flange in the female dimorph. Of the Decorah species referred to the genus, *P. antecedens* differs from *P. carinifera* and *P. staufferi* in its bearing two sizes of granules; all are new species, and only the last has been observed to be dimorphic.

PARABOLBINA ANTECEDENS Kay, n. sp.
Plate 32, figures 22–24

Valves medium in size, similar. Outline truncate elliptical; hinge quite long; dorsal margin straight, joining ends in rounded obtuse angles; free margins regularly curved; ends similar; retral swing slight. Surface quite convex, rising steeply from all margins; distinct posteriorly concave sulcus one-third valve length from posterior; defining convex lobe to posterior that is thickest part of valve; continuing along venter into regularly convex anterior lobe, with low node in centroventral; surface with fine granules and relatively fewer irregularly distributed larger granules. Contact seems simple, bordered by 35 to 40 larger granules on free margins; row of smaller granules bordering hinge.

Holotype no. 27583 C. (Ion shales, 60 feet above McGregor limestone, south of Cannon Falls, Minn.): length, 1.07 mm; width, 0.65 mm; thickness, 0.53 mm.

Single well-preserved specimen. The species resembles *Ctenobolbina ciliata* (Emmons) but lacks the anterior sulcus and the narrow marginal flange of that species; the two sizes of granules are distinctive.

PARABOLBINA CARINIFERA
Kay, n. sp.
Plate 32, figures 28–31

The species differs from *P. antecedens* in having a continuous narrow flange along the free margins, separated by a channel from the granuled border; the granules on the lateral surface are small and of one size; the node posterior to the sulcus is distinct and not granulate.

Holotype no. 27584 C. (Ion member, Decorah formation, sec. 6, Glenwood Township, Winneshiek County, Iowa): length, 0.91 mm; width, 0.50 mm; thickness about 0.40 mm, the specimen being crushed.

In addition to the holotype, a second, unflanged specimen may represent a dimorph though the flange of the holotype seems too narrow for it to represent a female form.

PARABOLBINA STAUFFERI Kay, n. sp.
Plate 32, figures 25–27

Valves medium in size, similar. Dimorphic; outline of male valve truncate elliptical; hinge long; dorsal margin straight, meeting ends in slightly obtuse angle; ends subequal. Surface rising rather steeply from free margins, more gently from dorsal; bearing distinct posteriorly concave sulcus posterior to midvalve, with distinct smooth mode on posterior; anterior and posterior lobes connected ventrally, where the surface is somewhat elevated, Female dimorph bearing a frill extending from midanterior margin along venter to near dorsoposterior angle, slightly convex laterally, separated from central surface by narrow depression. Surface rather coarsely granular, finely granular on flange. Contact seems plane, separated from flange by broad channel, bordered by row of some 50 or 60 small granules.

Holotype no. 27585 C. (Ion shale, 60 feet above McGregor limestone, 6 miles south of Cannon Falls, Minn.): length, 0.87 mm; width, 0.65 mm; thickness one valve, 0.26 mm—a female form.

Uncommon in Guttenberg and Ion members, one or two specimens having been found in several collections from Iowa and Minnesota. The species is a little more coarsely granulated on the lateral surface than *P. carnifera;* and if the type specimen of the latter be a female form, there is a much broader flange on *P. staufferi.*

Subfamily DILOBELLINAE
Kay, n. subfam.
Genus DILOBELLA
Ulrich, 1894, emended

Genotype, *Dilobella typa* ULRICH, *1894*, Geology Minnesota, vol. 3, pt. 2, p. 673, pl. 46, figs. 30–34. ("Upper third of Trenton shales" – Ion member, Decorah formation, St. Paul, Minn.). —SWARTZ, *1936*, Jour. Paleontology, vol. 10, pp. 551, 552, 554.

Dilobella typa Ulrich, the genotype, is a poorly preserved part of a specimen of *Ctenobolbina crassa* Ulrich, the latter becoming a synonym. *Ctenobolbina fulcrata* Ulrich is in turn the female dimorph of *C. crassa*. The dimorphism in the genus was suggested by Swartz, and is clearly evidenced in the specimens. The posterodorsal pits have similarity to the posteroventral pits in *Tetradella*, though the latter are rather depressions in an essentially entire surface than partitioned parts of a marginal channel; the hingement in the two genera is also similar. However, similar forms of dimorphism are represented in other genera that seem to bear little similarity in general form to *Dilobella*, and the genus is retained in the Primitiidae because of its having a single prominent sulcus bordered by undivided lobes.

The Decorah faunules have, in addition to *Dilobella typa* and the synonymous *D. crassa* and *D. fulcrata*, the species *D. simplex*, n. sp.

DILOBELLA TYPA Ulrich
Plate 33, figures 8–16

Dilobella typa ULRICH, *1894*, Geology Minnesota, vol. 3, pt. 2, p. 673, pl. 46, figs. 30–34. ("Upper third of Trenton shales"—Ion member, Decorah formation, St. Paul, Minn.); incomplete specimens.

Ctenobolbina fulcrata ULRICH, *1894*, Geology Minnesota, vol. 3, pt. 2, p. 674, pl. 44, figs. 8–11 (same horizon and locality as *D. typa*); a female dimorph.

Ctenobolbina crassa ULRICH, *1894*, Geology Minnesota, vol. 3, pt. 2, p. 675, pl. 44, figs. 12–16 (same horizon and locality as *D. typa*); entire male dimorph.

Valves medium in size, similar. Outline dorsally truncate suboval; hinge rather long; dorsal margin with projecting lateral lobes interrupting linear margin, meeting terminal margins angularly; free margins regularly curved, anterior most sharply; retral swing apparent. Dimorphic, surface of male valve (*C. crassa* Ulrich) bearing deep, slightly arcuate, broad sulcus, extending from midventer to dorsal margin, concave posteriorly; bordered anteriorly by ventrally widening lobe forming greatest valve thickness anteroventral to center; similar lobe posterior sulcus less elevated, joining anterior along venter, which is relatively depressed; anterodorsal surface relatively depressed. Lobes margined ventrally and posteriorly by broad, peripherolaterally facing channel, separated by marginal

flange from narrower marginal peripherally facing channel; surface smooth. Female dimorph (*C. fulcrata* Ulrich) having peripheral margin of lobes extended, with partitions crossing dorsal part of posterior end of the broader, inner channel; these square to subcircular pits typically two in number, considered to be brood pouches. Contact having narrow ridge on one valve fitting in groove on the other; not consistent as to left or right valve. Interior with broad partition corresponding to external sulcus; free margins joining hinge in broad obtuse angles.

Holotype of *Ctenobolbina fulcrata*, no. 41322 US. (Ulrich): length, 1.2 mm; width, 0.78 mm; thickness, 0.56 mm. Holotype of *Ctenobolbina crassa*, no. 41497 US. (Ulrich): length, 0.94 mm; width, 0.60 mm; thickness, 0.60 mm.

Common in Ion member of Decorah formation in Minnesota and near Ellsworth, Wis.; uncommon at several localities in Iowa; not found in the Guttenberg member.

DILOBELLA SIMPLEX Kay, n. sp.
Plate 33, figures 17–19

Valves small, similar. Outline truncate suboval; hinge straight, fairly long; dorsal margin straight, meeting anterior with greater obtuse angle than posterior; free margins regularly curved; retral swing evident. Valves quite thick; surface rising steeply from terminal margins, abruptly from ventral; bearing distinct, arcuate sulcus extending from midventral to middle of dorsal margin, concave posteriorly; bordered anteriorly by broad lobe, rising ventrally to thickest point on valve; joining posterior, broadly convex lobe ventral to sulcus, lobe extending to ventral margin; anterior border relatively depressed; surface seems smooth. Contact plane, with slightly thickened border.

Holotype no. 27581 C. (Ion member, Decorah formation, 50 feet above McGregor limestone, near Ellsworth, Wis.): length, 0.63 mm; width, 0.37 mm; thickness, 0.40 mm.

The holotype is the only specimen. The species differs from the genotype in lacking the marginal channels, and is smaller.

Genus CERATOPSIS Ulrich, 1894

Genotype, *Beyrichia chambersi* MILLER, *1874*, Cincinnati Quart. Jour. Sci., vol. 1, p. 234, fig. 27 (Cincinnatian Eden group, Cincinnati, Ohio). *Ceratopsis chambersi* ULRICH, *1894*, Geology Minnesota, vol. 3, pt. 2, p. 675.

The genus has a posteriorly concave median sulcus comparable to that in *Dilobella;* the anterior lobe is dorsally divided, and the posterior lobe, depressed behind the node, bears projecting structures near the posterodorsal margin. The Decorah fauna contains *C. quadrifida* (Jones) and a new species *C. humilinoda.*

CERATOPSIS QUADRIFIDA (Jones)

Beyrichia quadrifida JONES, *1891*, Canada Geol. Surv., Contr. Micro-Paleontology, pt. 3, p. 66, figs. 9a, b (basal Trenton, Lorette Falls, St. Charles River, Quebec).

Ceratopsis quadrifida ULRICH and BASSLER, *1909*, U. S. Nat. Mus., Proc., vol. 35, pl. 39, figs. 21, 22; —KAY, *1934*, Jour. Paleontology, vol. 8, p. 340, pl. 44, fig. 27.

The species has been sufficiently described in the last reference.

Frequent in the Ion member of the Decorah formation in Iowa, Minnesota and Wisconsin; also present in the Hull and Sherman Fall formations in Ontario.

CERATOPSIS HUMILINODA Kay, n. sp.
Plate 33, figures 6, 7

Valves small, similar. Outline subsemicircular; hinge relatively long; dorsal margin sinuous, joining anterior in curve, posterior nearly at right angles; anterior margin more sharply curved. Surface rising gently from terminal, more steeply from ventral margin; bearing an oblique sulcus extending posterodorsally from midvalve, separated by rounded lobe from similar sulcus in midposterior; short, rounded spine within posterodorsal margin, projecting beyond hinge dorsally; surface smooth. Contact simple.

Holotype no. 27582 C. (Ion shale, 60 feet above McGregor limestone, south of Cannon Falls, Minn.): length, 0.41 mm; width, 0.23 mm; thickness, 0.18 mm.

Holotype the only collected specimen, preserving both valves. The species differs from *C. quadrifida* in its small size, undivided anterior lobe, and in having a small posterodorsal node rather than a serrate spine.

Subfamily BOLLIINAE Bouček, 1936

Bolliinae BOUČEK, *1936*, Neues Jahrb., Beilage-Band 76, pt. B, p. 40.
Drepanellidae (part) SWARTZ, *1936*, Jour. Paleontology, vol. 10, p. 552.

The Decorah fauna contains two species, *B. subaequata* Ulrich, and *Dicranella simplex* Ulrich, that are referred to the genus *Bollia*. The genera *Drepanella* and *Scofieldia* are doubtfully referred to the subfamily; if they properly belong in the subfamily, the name becomes Drepanellinae Ulrich and Bassler, 1923.

Genus BOLLIA Jones and Holl, 1886

BOLLIA SUBAEQUATA Ulrich
Plate 32, figure 32

Bollia subaequata ULRICH, *1894*, Geology Minnesota, vol. 3, pt. 2, p. 669, pl. 46, figs. 26–29 ("*Clitambonites*"—Vellamo bed, Prosser formation, Cannon Falls, Minn.); —KAY, *1936*, Jour. Paleontology, vol. 8, p. 336, pl. 44, figs. 6–16.

The latter description seems adequate.

The most abundent of the species in the Ion member in northeastern Iowa; wholly unknown in the Guttenberg member; though the species was not found in collections from Minnesota and Wisconsin, the types came from the basal Prosser beds in Minnesota. Common also in the Hull formation in Ontario; and the same or a similar species is found in higher Trenton beds in the Mississippi Valley and Ontario.

BOLLIA SIMPLEX (Ulrich)
Plate 32, figures 33, 34

Dicranella simplex ULRICH, *1894*, Geology Minnesota, vol. 3, pt. 2, p. 666, pl. 44, figs. 24, 25; pl. 46, fig. 42. (*Rhinidictya* bed—Guttenberg member, Decorah formation, near Fountain, Minn.)

Valves small, similar. Outline suboval; hinge straight, about half valve length; dorsal margin somewhat irregular because of projecting lobes, curving regularly into terminal margins; free margins regularly curved, ends subequal. Surface of valves convex; rising gently from anterior and ventral margins, more steeply from posterior; distinct dorsal sulcus little posterior to midlength, bordered anteriorly by indistinct lobe having prominent dorsal node; smaller lobe posterior to sulcus, separated from faint marginal lobe by shallow depression; anterior and ventral surface regularly convex, tending to be slightly concave anterior to anterior lobe; surface smooth. Contact seems plane.

Holotype no. 41367 US. (Ulrich): length, 0.98 mm; width, 0.67 mm; thickness, 0.35 mm.

The species is represented by specimens smaller than the type but of similar character; *Jonesella obscura* Ulrich is similar if not identical. All three are very like *Bollia subaequata* in the character of the central lobes; though there is no continuous marginal lobe, there is a distinct posterior intramarginal swelling and an obscure depression anterior to the anterior lobe.

The Decorah specimens have come from the Ion member at Ion, Iowa, where they are uncommon.

Genus MARATIA Kay, n. gen.

Genotype, *Maratia mara* KAY, n. sp. (shales in Sherman Fall formation, near Gamebridge, Ontario).

This genus resembles *Bollia* in having an intramarginal lobe within the free margins and, typically, in having two nodes bordering the posterocentral sulcus; the latter are not connected ventrally, and the anterior node is not isolated from the anterior intramarginal lobe in the species *M. micula* (Ulrich); the surface is typically punctate.

The genotype is described, though it is not found in the Decorah fauna.

MARATIA MARA Kay, n. sp.
Plate 32, figures 35, 36

Valves small, similar. Outline truncate subelliptical; hinge rather long; dorsal margin straight; free margins regularly curved; ends subequal. Surface rising steeply from free margins to broadly convex intramarginal ridge; dorsal sulcus a little posterior to midlength, having a discrete small oval node behind; longer vertical node anterior to sulcus extending to dorsal margin, having shallow depression separating it from the anterior intramarginal lobe; surface except on central nodes bearing many small distinct punctae. Contact seems simple, with depressed border on the anterior.

Holotype no. 27590 C. (Sherman Fall formation of the middle Trenton, near Gamebridge, Victoria County, Ontario):

length, 0.41 mm; width, 0.28 mm; thickness, 0.22 mm.

The species is abundant in the beds at its type locality. The specific and generic names come from Mara Township, in which the type locality is located.

MARATIA MICULA (Ulrich)
Plate 32, figures 37, 38

Primitia micula ULRICH, *1894*, Geology Minnesota, vol. 3, pt. 2, p. 653, pl. 43, figs. 69–72, ("Galena shales"—Ion member, Decorah formation, or basal Prosser formation, Cannon Falls, Minn.)

The species is similar to *M. mara*. The anterior central node is continuous with the anterior intramarginal lobe, forming a single gently convex anterior lobe; and the posterior and posteroventral surface is broader and rises regularly toward the valve center. The sulcus is distinct, and the posterior node is separated by a narrow depression from the posterior lobe. The punctation is somewhat coarser than in *M. mara*.

Holotype no. 41336 US. (Ulrich): length, 0.39 mm; width, 0.25 mm; thickness, 0.23 mm.

Found only in the Ion member in Iowa, where it is abundant at a single locality, near Church; not found in the Guttenberg member.

Genus PARENTHATIA Kay, n. gen.

Genotype, *Moorea punctata* ULRICH, *1894*, Geology Minnesota, vol. 3, pt. 2, p. 682, pl. 43, figs. 84–88. ("Phylloporina" bed—Ion member, Decorah formation, Minneapolis, Minn.)

The genus includes subelliptical forms having a longitudinally concave surface with terminal arcuate ridges. The two Decorah species, *P. punctata* (Ulrich) and *P. camerata*, n. sp. are punctate, and seem to have plane contacts.

PARENTHATIA PUNCTATA (Ulrich)
Plate 32, figures 43, 44

Moorea punctata ULRICH, *1894*, Geology Minnesota, vol. 3, pt. 2, p. 682, pl. 43, figs. 84–88. ("Phylloporina" bed—Ion member, Decorah formation, Minneapolis, Minn.)

Valves small, similar. Outline truncate elliptical; hinge straight, relatively long; dorsal margin straight, joining free margins with slight angularity; free margins regularly curved, ends subequal. Surface rising gently from dorsal margin, more steeply from free margins; similar arcuate ridges near the ends of the valve limit a relatively depressed central surface, giving a concave longitudinal profile; central area finely punctate in well-preserved specimens. Contact seems plane, with a slightly concave border.

Holotype no. 41684 US. (Ulrich): length, 0.40 mm; width, 0.24 mm; thickness one valve, 0.18 mm.

Frequent in the Ion member at several localities in Iowa, Minnesota and western Wisconsin, but never common.

PARENTHATIA CAMERATA Kay, n. sp.
Plate 32, figures 45, 46

Valves medium in size, similar. Outline slightly truncate elliptical to subquadrate; dorsal margin straight, hinge about two-thirds valve length; free margins regularly curved, posterior very broadly so; ends subequal, retral swing slight. Surface rising steeply from dorsal margin, very steeply from free margins, to broad, slightly convex lateral surface; low arcuate swellings within terminal margins; bearing irregularly distributed small punctae, inconspicuous in most specimens. Contact seems plane.

Holotype no. 27389 C. (Ion member, sec. 6. Glenwood Township, Winneshiek County, Iowa): length, 0.79 mm; width, 0.45 mm; thickness one valve, 0.15 mm.

One of the more common Decorah species, being represented in most faunules, particularly those from the Ion member. The species differs from *P. punctata* in its larger size, subquadrate outline, relatively less prominent terminal ridges, and more extended and flatter central area.

Genus KIESOWIA
Ulrich and Bassler, 1908

Kiesowia ULRICH and BASSLER, *1908*, U. S. Nat. Mus., Proc., vol. 35, p. 307;—ÖPIK, *1937*, Nat. Soc. Tartu Univ., Annales, vol. 43, p. 31.

Genotype, *Beyrichia dissecta* KRAUSE, *1892*, Deutsche geol. Gesell., Zeitschr., vol. 44, p. 292, pl. 21, fig. 3. (Ordovician Drift, Germany.)

Valves small, similar. Outline truncate elliptical. Surface relatively depressed, with thickened border; bearing a variable num-

ber of distinct nodes within. Contact seems simple.

This genus, which has been compared to *Tetradella* in the past, is most similar to the genus *Ulrichia*, having two dorsal nodes and a reticulate surface as in that genus; it differs principally in having a number of marginal and submarginal nodes.

KIESOWIA VERRUCOSA Kay, n. sp.
Plate 32, figures 39, 40

Valves small, similar. Outline truncate elliptical, with dorsally projecting nodes; hinge straight, quite long; dorsal margin straight, meeting terminal margins angularly; free margins regularly curved, anterior trending posteroventrally, ventral rather straight, curving sharply into posterior; retral swing apparent. Surface relatively depressed, rising abruptly on free margins, more gently on dorsal; having prominent subconical blunt spine centered a little anterior to middorsal, extending dorsally and a little laterally, projecting beyond hinge; very small subconical node posterodorsal to midvalve; posterior margin having two nodes, the larger midposterior, extending laterally, and the smaller projecting dorsally at the posterodorsal angle; anterodorsal margin having a minute node; surface of depressed part of valve reticulately pitted. Contact plane, bordered by narrow channel within thickened border.

Holotype no. 27588 C. (Ion shale, 60 feet above McGregor limestone, 6 miles south of Cannon Falls, Minn.): length, 0.45 mm; width, 0.26 mm; thickness, 0.25 mm; a complete specimen.

The holotype is the only specimen found. This pretty little species is similar to *K. pernodosa* Öpik, which has a more prominent thickened margin, and a prominent ventral node, less conspicuous middorsal node; in no described species of the genus do the nodes project so far beyond the dorsal margin.

Genus DICRANELLA Ulrich, 1894

Genotype, *Dicranella bicornis* ULRICH, *1894*, Geology Minnesota, vol. 3, pt. 2, p. 665, pl. 44, fig. 26; pl. 46, figs. 39, 40 (*Rhinidictya* bed—Guttenberg member, Decorah formation, Minneapolis, Minn.).

Valves medium in size, similar. Outline truncate elliptical. Surface bearing distinct posterodorsal sulcus or pit, bordered on each side by dorsally spinose lobes; posteroventral margins in some specimens having a slightly elevated broad frill, obscuring valve contact. This frill seems dimorphic, and is absent in comparable specimens. Contact seems plane, commonly bordered by a row of granules or small spines.

The species *D. bicornis* Ulrich and *D. marginata* Ulrich are represented in the collections; an additional species, *D. spinosa* Ulrich, has been described from the Guttenberg member in Minnesota.

DICRANELLA BICORNIS Ulrich
Plate 33, figures 1–3

Dicranella bicornis ULRICH, *1894*, Geology Minnesota, vol. 3, pt. 2, p. 665, pl. 44, fig. 26, pl. 46, figs. 39, 40. (*Rhinidictya* bed—Guttenberg member, Decorah formation, Minneapolis, Minn.)

Valves medium in size, similar. Outline truncate oval; dorsal margin straight, with projecting spines; meeting anterior at right angle, posterior in rounded obtuse angle; anterior margin regularly curved, with projecting marginal nodes; ventral and posterior margins regularly curved, joining anterior in anteroventral with some projection. Surface quite plane, with posterodorsal sulcus or pit, terminated abruptly above midheight; having similar dorsally extending and diverging spinelike lobes on each side, projecting beyond dorsal margin; posterior and ventral margins having broad, flat flange, somewhat elevated above central part of valve, obscuring contact; this is believed to be a female form. Contact seems plane, bordered by a few large granules or nodes along the anteroventral and anterior margin.

Holotype no. 41366 US. (Ulrich): length, 1.8 mm; width, 1.02 mm.

Only a single entire specimen was collected, from the Ion member near Cannon Falls, Minn.

DICRANELLA MARGINATA Ulrich
Plate 33, figure 4

Dicranella marginata ULRICH, *1894*, Geology Minnesota, vol. 3, pt. 2, p. 666, pl. 44, figs. 27, 28. (*Rhinidictya* bed—Guttenberg member, Decorah formation, Fountain, Minn.)

The species is adequately described by

Ulrich. The striate frill along the posterior and ventral margins suggests that the species is dimorphic and that the type is a female form.

Holotype no. 41368 US. (Ulrich): length, 1.7 mm; width, 1.22 mm; thickness, 1.0 mm.

The single specimen illustrated is from the Ion member in Iowa, and it is the only one collected.

DICRANELLA SPINOSA Ulrich
Plate 33, figure 5

Dicranella spinosa ULRICH, *1894*, Geology Minnesota, vol. 3, p. 2, p. 665, pl. 44, fig. 23; pl. 46, fig. 41 (*Rhinidictya* bed—Guttenberg member, Decorah formation, Minneapolis, Minn.)

The typical form has been adequately described by Ulrich. That this is a female dimorph is suggested by the presence of a posteriorly nonfrilled specimen from the Ion member in Iowa; the specimen is incomplete anteriorly but preserves the central and posterior portions. The surface is regularly convex posterior to the posterior node, rising gently from a rather narrow, flat, thickened marginal border; the surface is very finely granulate.

Holotype no. 41369 US. (Ulrich): length, 1.8 mm; width, 0.83 mm; thickness, one valve, 0.45 mm.

Represented in the collection by a single valve from the Ion member, Glenwood Township, Winneshiek County, Iowa.

Genus SCOFIELDIA
Ulrich and Bassler, 1908

Genotype, *Drepanella bilateralis* ULRICH, *1894*, Geology Minnesota, vol. 3, pt. 2, p. 671, pl. 46, figs. 35–38. ("Upper third of Trenton shales"—Ion member, Decorah formation, St. Paul, Minn.) *Scofieldia bilateralis* ULRICH and BASSLER, *1908*, U. S. Nat. Mus., Proc., vol. 35, p. 314.

SCOFIELDIA BILATERALIS (Ulrich)

The original description and illustrations are sufficient. A single perfect specimen was found in the Ion member in Glenwood Township, Iowa; it was not recognized elsewhere, though some fragments may belong to the species.

Subfamily AECHMININAE Bouček, 1936

Aechmininae BOUČEK, *1936*, Neues Jahrb., Beilage-Band 76, pt. B, p. 41.

Genus AECHMINA Jones and Holl, 1869

Genotype, *Aechmina cuspidata* JONES and HOLL, *1869*, Annals and Mag. Nat. History, vol. 3, no. 4, p. 218, fig. 2, pl. 14, fig. 8. (Silurian, England.)

AECHMINA IONENSIS Kay, n. sp.
Plate 33, figures 31–33

Valves small, similar. Outline truncate elliptical; hinge straight, quite long; dorsal margin straight, slightly obscured by dorsal spine; meeting anterior margin with rounded obtuse angle, posterior with broader angle; free margins regularly curved, meeting subangularly; retral swing obvious, the anterior end being the shorter. Surface rising gently from free margins, more steeply from dorsal; having long, stout, dorsolaterally projecting spine with base within dorsal margin posterior to center; surface smooth. Contact plane.

Holotype no. 27591 C. (Ion member, six miles south of Cannon Falls, Minn.): length, 0.75 mm; width, 0.44 mm; thickness, 0.56 mm.

Only a single specimen, the holotype, has been found. The species is very similar to *A. richmondensis* Ulrich and Bassler, a Cincinnatian form; the Decorah form is relatively longer and narrower.

Family PRIMITIOPSIDAE Swartz, 1936

Primitiopsidae SWARTZ, *1936*, Jour. Paleontology, vol. 10, p. 555.

Genus PRIMITIOPSIS Jones, 1887

Genotype, *Primitiopsis planifrons* JONES, *1887*, Sil. Ostrac. Gothland, p. 5, text fig. (Silurian, Gothland).

The Decorah formation contains a new species, *Primitiopsis? bella*, which is similar to the genotype in having a shallow sulcus with a doubtful median pit, in being coarsely punctate, and, from comparison with *Primitiella constricta*, being dimorphic in the anterior. *Primitiella planifrons* also has dimorphism at the opposite end of the valve from the sulcus, but differs in having a terminal brood pouch.

PRIMITIOPSIS? BELLA Kay, n. sp.
Plate 33, figures 20, 21

Valves small, similar. Outline elongate suboval, narrowing slightly posteriorly;

hinge straight; margins regularly curved, ends similar. Surface rather regularly convex, rising steeply from anterior margin, more gently from others; having an ill-defined posteromedian sulcus, separating the relatively depressed posterior lobe from the more elevated, broadly convex anterior lobe; some specimens have an enlarged pit in the sulcus suggestive of that in the genotype. Surface having conspicuous subcircular to polygonal pits with narrow interridges, tending to be quincunxially arranged terminally, somewhat linearly, centrally. Contact seems plane; slightly channeled border on free margins.

Holotype no. 27576 C. (Ion shale, 55 feet above McGregor limestone, six miles south of Cannon Falls, Minn.): length, 0.54 mm; width, 0.30 mm; thickness one valve, 0.14 mm.

Rare to frequent in the Ion member at several localities in Iowa and Minnesota.

Genus PRIMITIELLA Ulrich, 1894

Genotype, *P. constricta* ULRICH, *1894*, Geology Minnesota, vol. 3, pt. 2, p. 647, pl. 43, figs. 48–53. ("Base of the Birdseye limestone"—probably Tyrone formation of Black River age, High Bridge, Ky.)

Valves small, equal. Outline subelliptical to subrectangular; dorsal and ventral margins linear. Surface moderately convex, having broad, ill-defined posterocentral sulcus. Probably dimorphic, anterior lobe, depressed in the male form, rising anteriorly in the female to form thickest part of valve; surface finely pitted. Contact seems plane, typically beaded.

The Decorah specimens referred to *P. constricta* are finely pitted, though previously described as smooth; and the pitted surface and dimorphic characters are also evident in *P. plattevillensis*, n. sp., an older species introduced for comparison. This anterior dimorphism is in contrast to the posterior dimorphism of genera of Primitiidae such as *Euprimitia*, *Eurychilina* and *Dilobella*, and seems to warrant the placing of the genus in a different family. In the principal characters, the genus resembles the species *Primitiopsis bella*, which seems closely related to the genotype of *Primitiopsis;* hence, the genus *Primitiella* is placed in the family *Primitiopsidae.* These genera in their anterior dimorphism resemble those in the family Kloedenellidae.

PRIMITIELLA CONSTRICTA Ulrich
Plate 33, figures 22–26

Primitiella constricta ULRICH, *1894*, Geology Minnesota, vol. 3, pt. 2, p. 647, pl. 43, figs. 48–53. ("Base of the Birdseye limestone"—probably Tyrone formation, High Bridge, Kentucky.)

Valves small, similar. Outline subquadrate elliptical; hinge straight, three-fourths valve length; dorsal margin straight or slightly concave, curving regularly into posterior margin, more sharply into anterior; anterior margin broadly arcuate, oblique, dorsally extended; ventral margin nearly straight; posterior, regularly curved; retral swing obvious. Probably dimorphic, male valves with surface rising gently from margins; broadly convex surface with posterocentral shallow depression; female dimorph with elevated anterior lobe, dropping abruptly to anterior margin; surface finely reticulately pitted except on anterior arcuate face. Contact seems plane, beaded, with shallow channel along ventral and posterior margin.

Holotype no. 41462 US. (Ulrich): length, 0.67 mm; width, 0.36 mm; thickness one valve, 0.24 mm.

Common in some faunules from the Guttenberg and Ion members, but not persistent; originally described from the Black River of Kentucky, and present in the Platteville formation. The form listed as this species from the Trenton of Ontario (Bassler and Kellett, 1934) is separable.

PRIMITIELLA PLATTEVILLENSIS Kay, n. sp.
Plate 33, figures 27–30

The description of this species, found in the Black River Platteville formation, is introduced because it illustrates the seemingly dimorphic character of the genus.

Valves medium in size, similar. Outline subelliptical; dorsal margin straight, quite long, joining terminal margins in obtuse angles, the anterior the sharper; anterior margin broadly arcuate, oblique, extended dorsally; ventral margin slightly curved, posterior subsemicircular; retral swing obvious. Probably dimorphic; surface in male form rising gently from all margins; pos-

terocentral broad depression bordered posteriorly by broadly convex posterior lobe; anterior surface more gently convex; in female form, anterior lobe rising anteriorly, rising steeply from anterior margin to thickest part of valve. Surface bearing numerous fine pits, elongate and linearly arranged within free margins, subcircular centrally. Contact seems plane, beaded along free margins; interior bearing broad partition corresponding to lateral sulcus.

Holotype no. 27575 C. (McGregor member, Platteville formation, along Pikes Hill Road, southeast of McGregor, Iowa): length, 0.78 mm; width, 0.47 mm; thickness one valve, 0.21 mm (female dimorph).

Common in shales within McGregor limestone at the type locality of the species. The species is somewhat larger than *P. constricta* and has elongate intramarginal pits. Specimens of *P. constricta* are associated with it.

Family BEYRICHIIDAE Ulrich, 1894

Beyrichiidae ULRICH, 1894, Geology Minnesota, vol. 3, pt. 2, p. 632.

Subfamily BEYRICHIINAE (Ulrich), 1894

Genus BROMIDELLA Harris

Genotype, *Bromidella reticulata* HARRIS, *1931*, Oklahoma Geol. Survey, Bull. 33, p. 93, pl. 14, figs. 6a, b. (Bromide formation, Arbuckle Mountains, Oklahoma.)

Valves medium in size, similar. Dimorphic, male valve subquadrate to elliptical; distinct posteromedian sulcus with discrete node to posterior; lobes along anterodorsal, anteroventral and posterior borders, the first typically isolated, the latter two varyingly connected. Contact seems simple. Female dimorph bearing convex border lobe along ventral and posteroventral margins, corresponding to internal arcuate pouch separated dorsally by narrow partition.

The genotype is granular and spinose; the two Decorah species, *B. depressa* and *B. rhomboides*, n. sp., are smooth and pitted, respectively. There are additional undescribed forms in the Platteville formation in Iowa, and in the lower and middle Trenton of Ontario; and *Beyrichia bella* Walcott is probably congeneric. The lobation of all these species seems sufficiently like that of the genotype to warrant their being included in a single genus. *Uhakiella* Öpik has a similar brood pouch, but the distribution of lateral lobes is quite different.

BROMIDELLA DEPRESSA Kay, n. sp.
Plate 34, figures 12–15

Valves medium in size, similar. Dimorphic, outline of male subquadrate elliptical; hinge quite long; dorsal margin sinuous, interrupted by lateral lobes, meeting anterior margin in rounded acute, posterior margin in rounded obtuse angle; free margins regularly curved; distinct retral swing. Surface irregularly convex; posteriorly concave sulcus behind midvalve; semispherical node within isolated by narrow depression from arcuate lobe within posterior and posterodorsal margin; depressed anterior border with elevated margin, continuous into very narrow depressed ventral border; elliptical lobe anterodorsal to midvalve separated by broad depression from similar but higher anteroventral lobe; shallow depression extending ventrally from posterocentral node; surface seems smooth. Contact seems plane. Female dimorph with convex border extending from anteroventral to midposterior; interruptedly contiguous with anteroventral and posterior lobes; corresponding isolated brood pouch in interior.

Holotype no. 27592 C. (Ion member, Decorah formation, near Cannon Falls, Minn.): length, 0.75 mm; width, 0.50 mm; thickness one valve, 0.23 mm (female dimorph).

Frequent in Ion member at many localities in northeastern Iowa, Minnesota and western Wisconsin; locally frequent in the Guttenberg member. Male valves resemble those of *Thomasatia falcicosta* Kay; they lack the entire marginal ridge of that species as well as the vertical lobe connecting the anterodorsal and anteroventral lobes.

BROMIDELLA RHOMBOIDES Kay, n. sp.
Plate 34, figures 16, 17

Valves medium in size, similar. Dimorphic, only female valves known; outline subrhombic; hinge quite long; dorsal margin convex, meeting anterior in rounded acute, posterior in rounded obtuse angle; free margins regularly curved. Surface rising quite steeply from all but ventroanterior margin. Surface irregularly convex, less deeply incised than in *B. depressa;* sulcus

and posteromedian node distinct; anterodorsal lobe encroaching on anterodorsal margin; anteroventral, ventral marginal and posterior marginal nodes forming fairly continuously convex surface, most elevated in anteroventral; surface closely pitted; interior bearing ventral and ventroposterior isolated brood pouch. Contact seems simple.

Holotype no. 27593 C. (Ion member, Ion, Allamakee County, Iowa): length, 0.65 mm; width, 0.51 mm (female form).

Uncommon in Ion member at a few localities in Iowa.

Genus OPIKATIA Kay, n. gen.

Genotype, *O. emaciata* Kay, n. sp. (Ion member, 5 feet from base, sec. 13, Glenwood Township, Winneshiek County, Iowa.)

Valves medium in size, similar. Dimorphic, valves similar in outline in two forms; truncate oval; hinge rather long; dorsal margin slightly sinuous; free margins regularly curved; ends subequal. Surface of male valve bearing median sulcus or pit, with distinct lobe to posterior; low node within dorsal margin anterior to midlength; linear lobe anteroventral to sulcus, thickest point on valve; female dimorph with three distinct rounded nodes within posterodorsal, midposterior, and posteroventral margins, with corresponding internal brood pouches; surface smooth or slightly pitted. Contact simple.

The genus is represented by two new species, *O. emaciata* and *O. rotunda*. It bears little resemblance to any described genus, the type of dimorphism being also unusual; *Bellornatia*, which has similar dimorphism, has strikingly different surface characters.

OPIKATIA EMACIATA Kay, n. sp.
Plate 34, figures 7–11

Valves medium in size, similar. Dimorphic, male valve truncate elliptical in outline; dorsal margin slightly sinuous, curving subangularly into free margins, which are regularly curved; ends subequal. Surface rising gently from dorsal, and terminal margins, abruptly from posterior thickened border; central area irregularly convex, with a node slightly posterodorsal to midvalve, a low elevation along dorsal margin anterior to midlength, and an anteriorly rising and slightly dorsally trending ridge in midventral, thickest point on valve; surface seems smooth. Female dimorph with nodes as in male valve, and three additional subcircular nodes within posterodorsal, midposterior and posteroventral margins.

Holotype no. 27594 C. (Ion member, sec. 13, Glenwood Township, Winneshiek County, Iowa): length, 0.60 mm; width, 0.39 mm; thickness one valve, 0.17 mm (female form).

Two specimens, one of each dimorph, were found at the type locality; it is rare in the Guttenberg and Ion members in Iowa.

OPIKATIA ROTUNDA Kay, n. sp.
Plate 34, figures 1–6

Valves medium in size, similar. Dimorphic, only female valves found; outline truncate elliptical; hinge long; dorsal margin straight to slightly convex; free margins regularly curved; ends subequal. Surface rising rather steeply from all but anterior margin, which has depressed border; median subcircular pit extending and narrowing dorsally, forming posteriorly concave sulcus; partially defining oval node; similar node anterodorsal to median pit, connected ventrally to broad, arcuate lobe in centroposterior abruptly terminated anteriorly, and connected to posteromedian node; posterior and posteroventral border with arcuate lobe, swollen within posterior and posteroventral margins; surface seems smooth. Contact plane.

Holotype no. 27595 C. (Ion member, 60 feet above McGregor limestone, 6 miles south of Cannon Falls, Minn.): length, 0.77 mm; width, 0.49 mm; thickness one valve, 0.28 mm (female form).

The species differs obviously from *O. emaciata* in its greater convexity and less sharply defined lobation. The valves of *Dilobella simplex* resemble the species and may possibly be male dimorphs; the male form of *O. rotunda* should have a smaller, more discrete posteromedian lobe and a distinct middorsal lobe.

Subfamily TETRADELLINAE (Swartz), 1936, new category

Tetradellidae SWARTZ, *1936*, Jour. Paleontology, vol. 10, p. 551.

Genus TETRADELLA Ulrich, 1890

Genotype, *Beyrichia quadrilirata* HALL and WHITFIELD, *1875*. Ohio Geol. Survey, Paleontology, vol. 2, p. 105, pl. 4, figs. 5–7 (Richmond group, Ohio). *Tetradella* ULRICH, *1890*, Cincinnati Soc. Nat. History, Jour., vol. 13, p. 112;—KAY, *1934*, Jour. Paleontology, vol. 8, p. 338;—SWARTZ, *1936*, Jour. Paleontology, vol. 10, p. 551.

It has been suggested by Swartz that the genus, as represented in the Decorah species *T. ellipsilira* Kay and *T. ulrichi* Kay, may be dimorphic. Each species has loculi, or partitions, projecting from the posterior and posteroventral marginal ridge. About two hundred specimens have been reexamined. As previously stated, there is great variation in the development of the structures; on one extreme, there are specimens with a depressed border having a pair of faintly developed loculi, defining a single marginal pit; at the other extreme are forms in which the lateral surface of the marginal ridge is extended peripherally along the posterior and ventral margins, and bears as many as five, or more commonly four, circular pits. The pits are comparable to those in *Dilobella typa*, and they are presumably of sexual significance; but there seems to be a gradation from forms lacking the marginal pits to those having them well developed.

TETRADELLA ELLIPSILIRA Kay
Plate 34, figures 18–22

Tetradella ellipsilira KAY, *1934*, Jour. Paleontology, vol. 8, p. 339, pl. 45, figs. 10–15. (Ion member, Glenwood Township, Winneshiek County, Iowa.)

The species has been adequately described. The character of the marginal pits is illustrated in the present paper.

Common to abundant in the Guttenberg and Ion members of Iowa, Minnesota and western Wisconsin. A number of specimens resembling *T. ellipsilira*, but of small size, have been considered to be varieties.

TETRADELLA ULRICHI Kay
Plate 34, figure 23

Tetradella ulrichi KAY, *1934*, Jour. Paleontology, vol. 8, p. 339, pl. 45, figs. 16–19. (Hull formation, Healey Falls, Ontario.)

The species has been adequately described.

Frequent, but never as common as *T. ellipsilira* in the Ion member in Iowa and Minnesota; it is the dominant species in the middle Trenton of Ontario.

Subfamily PIRITELLINAE
(Öpik), 1937, new category

Piritellidae ÖPIK, *1937*, Nat. Soc. Tartu Univ., Annales, vol. 43, p. 46.

Genus BELLORNATIA Kay, 1934

Genotype, *B. tricolis* KAY, *1934*, Jour. Paleontology, vol. 8, p. 342, pl. 44, figs. 22–26. (Ion member, sec. 6, Glenwood Township, Winneshiek County, Iowa.)

Further study of the genotype suggests that the genus is dimorphic. The Decorah collections contain two specimens, both bearing three rounded swellings within the posteroventral margin; a similar form from the upper Black River Glenburnie shale of Ontario has similar structures. A number of specimens collected from the Hull shales at Healey Falls, Ontario, two of which are illustrated in the previous paper and another in the present, lack the intramarginal swellings but have ridges and anterior node as in the other form; they lack the posterocentral nodes. These latter forms seem so similar in their principal structures to the genotype, that it is believed that they are congeneric, and they are considered to be conspecific, though this may be incorrect. If they be conspecific and the dimorphism posterior, it is the anterior rather than the posterior central node that persists.

BELLORNATIA TRICOLLIS Kay
Plate 34, figures 24–26

Bellornatia tricollis KAY, *1934*, Jour. Paleontology, vol. 8, p. 342, pl. 44, figs. 22–26. (Ion member, Iowa.)

The original description is essentially adequate; the question of dimorphism has been discussed under the generic description. Rare in the Ion member of northeastern Iowa.

Genus BASSLERATIA Kay, 1934

Genotype, *B. typa* KAY, *1934*, Jour. Paleontology, vol. 8, p. 341, pl. 46, figs. 1–12. (Hull formation, Healey Falls, Ontario.)

BASSLERATIA TYPA Kay

Bassleratia typa KAY, *1934*, Jour. Paleontology, vol. 8, p. 341, pl. 46, figs. 1–12. (Hull formation, Ontario).

The species has been adequately described. Abundant in the basal Ion shale at Ion, Iowa; rare in other faunules from Iowa; abundant in the Hull formation at Healey Falls, Ontario.

Genus THOMASATIA Kay, 1934

Genotype *T. falcicosta* KAY, *1934*, Jour. Paleontology, vol. 8, p. 337, pl. 46, figs. 13–23. (Hull formation, Healey Falls, Ontario.)

THOMASATIA FALCICOSTA Kay

Plate 34, figure 29

Thomasatia falcicosta KAY, *1934*, Jour. Paleontology, vol. 8, p. 337, pl. 46, figs. 13–23. (Hull formation, Ontario.)

The species has been adequately described. Frequent to common in the Ion member in Iowa and Minnesota, and in the Guttenberg member in northeastern Iowa.

Genus RAYMONDATIA Kay, 1934

Genotype, *R. goniglypta* KAY, *1934*, Jour. Paleontology, vol. 8, p. 342, pl. 45, figs. 7–9. (Ion member, Glenwood Township, Winneshiek County, Iowa.)

This genus seems so different from other genera of Ostracoda that its classification is uncertain.

RAYMONDATIA GONIGLYPTA Kay

Plate 34, figures 30, 31

Raymondatia goniglypta KAY, *1934*, Jour. Paleontology, vol. 8, p. 342, pl. 45, figs. 7–9. (Ion member, Iowa.)

The species has been adequately described. It is uncommon to frequent in the Guttenberg and Ion members in Iowa, Minnesota and western Wisconsin; and is present in shales in the McGregor limestone of the Platteville formation in Iowa, and in the Hull formation in Ontario.

Family BEECHERELLIDAE Ulrich, 1894

Beecherellidae ULRICH, *1894*, Geology Minnesota, vol. 3, pt. 2, p. 632.

Genus KRAUSELLA Ulrich, 1894

Genotype, *Krausella inaequalis* ULRICH, *1894*, Geology Minnesota, vol. 3, pt. 2, p. 692, pl. 44, figs. 44–46. (Platteville formation, Dixon Illinois.)

The Decorah fauna contains *K. curtispina* Kay, n. sp., specimens referred to *K*

EXPLANATION OF PLATE 33

All figures approximately ×30

FIGS. *1–3—Dicranella bicornis* Ulrich. *1, 2*, Ventral and right lateral views of hypotype 27646C, female, bivalved, Ion member, Cannon Falls, Minn. *3*, Lateral view of hypotype 27647C, male, right valve, incomplete, lower part of Guttenberg member, sec. 13, Glenwood Township, Iowa. (p. 260)

4—Dicranella marginata Ulrich, lower part of Ion member, Ion, Allamakee County, Iowa. Lateral view of hypotype 27654C, female, right valve. (p. 260)

5—Dicranella spinosa Ulrich, upper part of Ion member, sec. 6, Glenwood Township, Iowa. Lateral view of hypotype 27655C, male, left valve, incomplete. (p. 261)

6, 7—Ceratopsis humilinoda Kay, n. sp., Ion member, Cannon Falls, Minn. Right lateral and dorsal views of holotype 27582C, bivalved. (p. 257)

8–16—Dilobella typa Ulrich. Ion member, Cannon Falls, Minn. *8–12*, Dorsal, lateral, interior, posterior, and ventral views of hypotype 27642C, female, left valve. *13–16*, Dorsal, posterior, ventral, and interior views of hypotype 27644C, male, right valve. (p. 256)

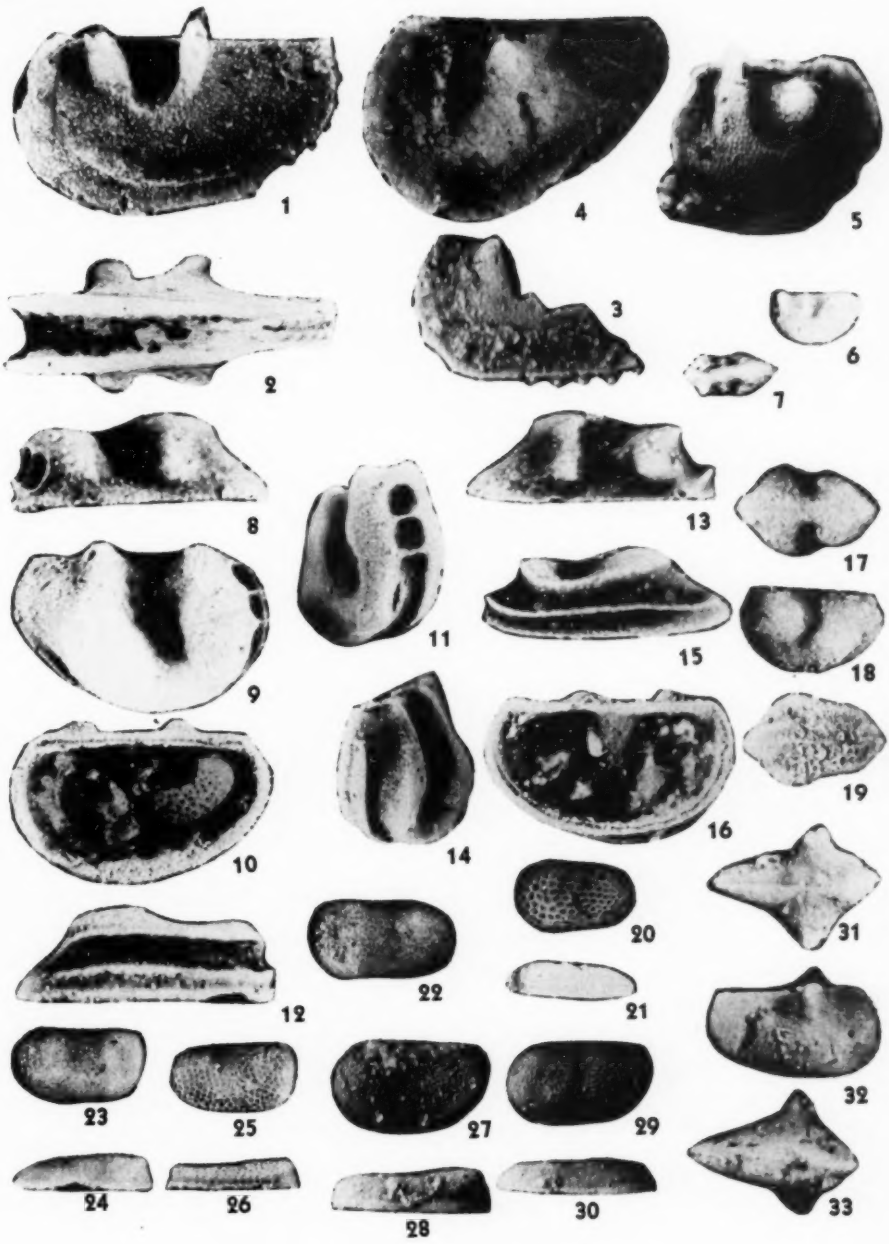
17–19—Dilobella simplex Kay, n. sp., Ion member, Cannon Falls, Minn. Dorsal, right lateral, and ventral views of holotype 27581C, bivalved. (p. 257)

20, 21—Primitiopsis? bella Kay, n. sp., Ion member, Cannon Falls, Minn. Lateral and ventral views of holotype 27576C, left valve. (p. 261)

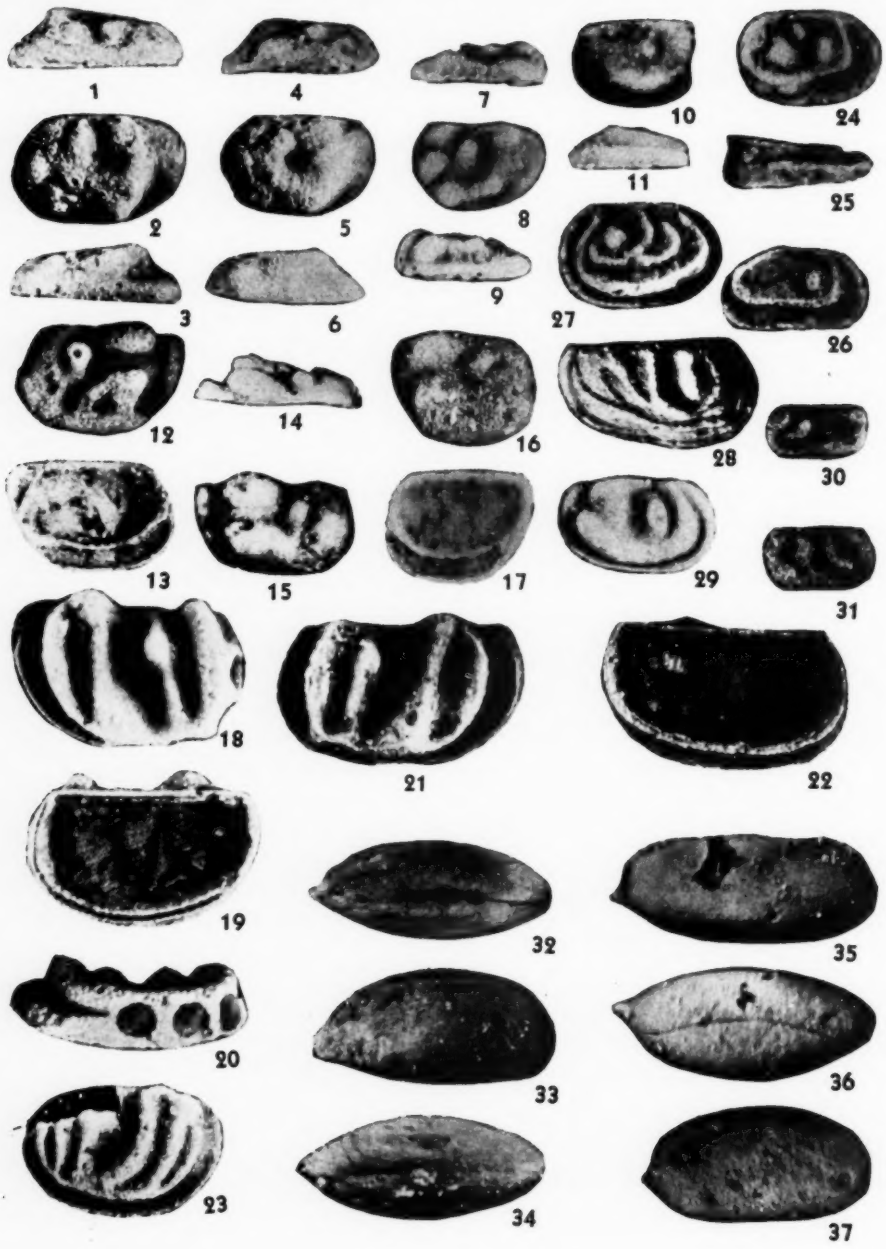
22–26—Primitiella constricta Ulrich, Ion member, Cannon Falls, Minn. *22*, Lateral view of hypotype 27656C, female, left valve. *23, 24*, Lateral and ventral views of hypotype 27657C, female, right valve. *25, 26*, Lateral and ventral views of hypotype 27658C, male, right valve. (p. 262)

27–30—Primitiella plattevillensis Kay, n. sp., McGregor member of Platteville formation, Pikes Hill, McGregor, Iowa. *27, 28*, Lateral and ventral views of holotype 27575C, female, right valve. *29, 30*, Lateral and ventral views of paratype 27659C, male, right valve. (p. 262)

31–33—Aechmina ionensis Kay, n. sp., Ion member, Cannon Falls, Minn. Dorsal, left lateral, and ventral views of holotype 27591C, bivalved. (p. 261)



Kay, Ordovician (Decorah) Ostracoda



Kay, Ordovician (Decorah) Ostracoda

arcuata Ulrich, and fragments of a much larger form that has not been specifically identified.

KRAUSELLA CURTISPINA Kay, n. sp.
Plate 34, figures 35–37

Valves medium in size, dissimilar, left valve overlapping the right along dorsal and ventral margins. Right valve subelliptical; dorsal and ventral margins very broadly curved; posterior margin interrupted by projecting spine. Surface broadly convex; bearing a short spine having its base within the ventroposterior margin, extending slightly beyond margin; posterior margin on interior regularly curved.

Holotype no. 27596 C. (Guttenberg member, sec. 13, Glenwood Township, Winneshiek County, Iowa): length, 1.37 mm; width, 0.57 mm; thickness, one valve, 0.59 mm, somewhat crushed.

Rare in the Guttenberg member in Iowa. The species is distinctive in the shortness of the spine, which in some specimens is little more than a node.

KRAUSELLA ARCUATA Ulrich

Krausella arcuata ULRICH, *1894*, Geology Minnesota, vol. 3, pt. 2, p. 692, pl. 44, figs. 47–53. ("Lower third of Trenton shales"—Guttenberg member, Minneapolis, Minn.)

The species has been described adequately by Ulrich; similar valves in the recent collections vary considerably in size and may represent more than a single species.

Holotype no. 41717 US. (Ulrich): length, 1.9 mm; width, 0.82 mm; thickness, about 0.58 mm.

Frequent in the Guttenberg and Ion members at several localities. The valves differ from those of *Rayella calvini* in lacking dorsal cardinal areas; left valves resemble those of *Bythocypris cylindrica* but are ventrally convex, and have similar convexity at each end.

Genus RAYELLA Teichert, 1939

Basslerites TEICHERT, *1937* (December 8), not *Basslerites* HOWE, in CORYELL and FIELDS, *1937* (November 1), Am. Mus. Nat. History, Novitates, no. 956, p. 11.

Rayella TEICHERT, *1939*, Jour. Paleontology, vol. 13, p. 622.

EXPLANATION OF PLATE 34

All figures approximately ×30

FIGS. *1–6—Opikatia rotunda* Kay, n. sp., Ion member, Cannon Falls, Minn. *1–3*, Dorsal, lateral, and ventral views of holotype 27595C, female, right valve. *4–6*, Dorsal, lateral, and ventral views of paratype 27661C, female, right valve. (p. 264)

7–11—Opikatia emaciata Kay, n. sp., middle part of Ion member, sec. 13, Glenwood Township, Iowa. *7–9*, Dorsal, lateral, and ventral views of holotype 27594C, female, right valve. *10, 11*, Lateral and ventral views of paratype 27662C, male, left valve. (p. 264)

12–15—Bromidella depressa Kay, n. sp., Ion member, Cannon Falls, Minn. *12, 13*, Lateral and interior views of holotype 27592C, female, right valve. *14, 15*, Dorsal and lateral views of paratype 27663C, male, left valve. (p. 263)

16, 17—Bromidella rhomboides Kay, n. sp., upper part of Ion member, sec. 6, Glenwood Township, Iowa. Lateral and interior views of holotype 27593C, female, left valve. (p. 263)

18–22—Tetradella ellipsilira Kay, Ion member, Cannon Falls, Minn. *18–20*, Lateral, interior, and posteroventral views of hypotype 27664C, female, left valve. *21. 22*, Lateral and interior views of hypotype 27665C, female, right valve. (p. 265)

23—Tetradella ulrichi Kay, upper part of Ion member, sec. 6, Glenwood Township, Iowa. Lateral view of hypotype 27666C, male, right valve. (p. 265)

24–26—Bellornatia tricollis Kay, upper part of Ion member, sec. 6, Glenwood Township, Iowa. Lateral and ventral views of holotype 27480C, female, right valve. (p. 265)

27—Bellornatia sp., cf. *B. tricollis* Kay, lower part of Hull formation, Healey Falls, Ontario. Lateral view of hypotype 27667C, male, right valve.

28—Pseudostrepula kuckersiana (Bonnema), Kukruse formation, Kohtla Järve, Estonia. Lateral view of hypotype, left valve, after Öpik (1937, pl. 6, fig. 2).

29—Thomasatia falcicosta Kay, Ion member, Cannon Falls, Minn. Lateral view of hypotype, left valve. (p. 266)

30, 31—Raymondatia goniglypta Kay, Ion member, Ellsworth, Wis. *30*, Lateral view of hypotype 27670C, right valve. *31*, Lateral view of hypotype 27671C, left valve. (p. 266)

32–34—Rayella calvini Kay, n. sp., lower part of Ion member, Ion, Allamakee County, Iowa. Dorsal, left lateral, and ventral views of holotype 27497C, bivalved. (p. 268)

35–37—Krausella curtispina Kay, n. sp., *35, 36*, Left lateral and ventral views of holotype 27596C, bivalved, upper part of Guttenberg member, sec. 13, Glenwood Township, Iowa. *37*, Lateral view of paratype 27660C, bivalved, somewhat crushed, Guttenberg member, Church, Iowa. (p. 267)

Genotype, *Basslerites hanseni* TEICHERT, *1937*, Fifth Thule Exped., Repts., vol. 1, no. 5, p. 117, pl. 23, figs. 11–15. (Ordovician, Washington Land, North Greenland.)

The genus includes "smooth small ostracodes, which are similar to *Krausella*, but in which the left valve does not overlap the right valve along the dorsal margin."

RAYELLA CALVINI Kay, n. sp.
Plate 34, figures 32–34

Valves small, dissimilar, left valve overlapping the right along ventral margin. Right valve posteroventrally attenuate, elongate subelliptical; hinge straight, short, obscured by broadly arcuate dorsal margin, which curves regularly into terminal margins; ventral margin slightly curved, continuing posteriorly along ventral side of short spinelike projection; anterior margin sinuous, concave along dorsal side of spine; surface rising rather gently from margins; centrodorsal surface continuing incurved to hinge; surface smooth, broadly convex longitudinally, strongly convex vertically. Left valve elongate subelliptical, slightly extended posteriorly; dorsal surface similar to that of right valve; interiorly recurved; spine of right valve extending beyond short spine on left.

Holotype no. 27597 C. (Ion member, 4 feet from base, Ion, Allamakee County, Iowa): length, 1.33 mm; width, 0.56 mm; thickness, 0.48 mm.

Represented by a few definitely identified specimens from the Ion member in Iowa and Minnesota. In the absence of bivalved specimens, separate valves of this species can be distinguished from those of *Krausella arcuata* by the presence of a narrow centrodorsal cardinal area. The species is similar to the genotype, but smaller, and relatively longer.

Family BAIRDIIDAE Sars, 1887

Bairdiidae SARS, *1887*, Arch. Math. Naturvid., vol. 12, 13, p. 288.

Genus BYTHOCYPRIS Brady, 1880

Genotype, *B. reniformis* BRADY, *1880*, Challenger Exped., Rept. Ostracoda, p. 46, pl. 5, figs. 1a–1. (Recent, Atlantic Ocean.)

Of the three species listed by Ulrich from the Decorah of Minnesota, *B. cylindrica* (Hall), *B. curta* Ulrich and *B. granti* Ulrich, only the first is abundantly represented in the present collections. The valves bear a subcircular, dense "muscle spot" a little anterior to their centers.

BIBLIOGRAPHY

BASSLER, R. S., *1911*, Early Paleozoic Bryozoa of the Baltic Provinces: *U. S. Nat. Mus., Bull.* 77.

——, and KELLETT, BETTY, *1934*, Bibliographic index of Paleozoic Ostracoda: *Geol. Soc. America, Spec. Paper* 1, 1934.

BONNEMA, J. H., *1909*, Beiträge zur Kenntnis der Ostrakoden der kuckersschen Schicht: *Miner. Geol. Groningen, Mitt.*, vol. 2, pp. 1–84.

——, *1932*, Orientation of the carapaces of Paleozoic Ostracoda: *Jour. Paleontology*, vol. 6, pp. 288–295.

BOUČEK, B., *1936*, Die Ostracoden des böhmischen Ludlows: *Neues Jahrb., Beilage Band* 76, Abt. B., p. 31098.

HARRIS, R. W., *1931*, Description of ostracodes and conodonts [of the Simpson Group]: *Oklahoma Geol. Survey, Bull.* 55, pp. 87–95.

KAY, G. M., *1929*, Stratigraphy of the Decorah formation: *Jour. Geology*, vol. 37, pp. 639–671.

——, *1934*, Mohawkian Ostracoda: Species common to Trenton faunules from the Hull and Decorah formations: *Jour. Paleontology*, vol. 8, pp. 328–343.

——, *1935*, Ordovician system in the Upper Mississippi Valley, *Kansas Geol. Soc., Ninth Conf., guidebook*, pp. 281–295, 1935.

——, and ATWATER, G. I., *1935*, Basal relations of the Galena dolomite in the Upper Mississippi Valley lead and zinc district, *Am. Jour. Sci.*, vol. 29, pp. 98–111.

ÖPIK, A., *1937*, Ostracoda from the Ordovician Uhaku and Kukruse formations of Estonia: *Nat. Soc. Tartu Univ., Annales* vol. 43.

RAYMOND, PERCY, *1916*, Expedition to the Baltic Provinces of Russia and Scandinavia: *Harvard College, Mus. Comp. Zool., Bull.*, vol. 56, pp. 179–286.

RUEDEMANN, RUDOLPH, *1901*, Trenton conglomerate of Rysedorph Hill, New York, and its fauna: *New York State Mus., Bull.* 49.

SARDESON, F. W., *1898*, Intraformational conglomerates in the Galena series: *Am. Geologist*, vol. 22, pp. 315–323.

——, *1928*, Bentonitic seams in stratigraphic correlation: *Pan-Am. Geologist*, vol. 50, pp. 107–116.

SWARTZ, F. M., *1936*, Revision of the Primitiidae and Beyrichiidae, with new Ostracoda from the Lower Devonian of Pennsylvania: *Jour. Paleontology*, vol. 10, pp. 541–586.

TEICHERT, CURT, *1936*, Ordovician and Silurian faunas from Arctic America; *Fifth Thule Exped., Repts.*, vol. 1, no. 5.

——, *1937*, A new Ordovician fauna from Washington Land, North Greenland: *Meddelelser om Grønland*, vol. 119, no. 1.

ULRICH, E. O., *1894*, Lower Silurian Ostracoda of Minnesota: *Geology Minnesota*, vol. 3, pt. 2, pp. 629–693.

——, and BASSLER, R. S., *1908*, New American Paleozoic Ostracoda: *U. S. Nat. Mus., Proc.*, vol. 35, pp. 277–340.

——, *1923*, Paleozoic Ostracoda: their Morphology, Classification and Occurrence: *Maryland Geol. Survey, Silurian*, pp. 271–391.

WARTHIN, A. S., JR., *1937*, Type invertebrate fossils of North America: Devonian Beyrichiidae: *Wagner Free Inst. Sci.*

WINCHELL, N. H., and ULRICH, E. O., Lower Silurian deposits of the Upper Mississippi Valley province: *Geology Minnesota*, vol. 3, pt. 2, pp. lxxxiii-cxxvii.

MANUSCRIPT RECEIVED BY THE EDITOR JUNE 5, 1939.

JOURNAL OF PALEONTOLOGY, VOL. 14, NO. 3, PP. 270–284, PLS. 35–40, MAY, 1940

PRISMATOPHYLLUM IN THE CEDAR VALLEY BEDS OF IOWA

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ABSTRACT—Eight species of Prismatophyllum from the Upper Devonian Cedar Valley limestone are described, seven of them as new forms. The genera *Prismatophyllum* and *Acervularia* are discussed and compared. *Prismatophyllum* cinctum, n. sp., from the Jeffersonville limestone, is described and figured. *Acervularia ananas* var. *ananas* (Linné), is redescribed and figured.

COMPOUND acervularioid corals are common in the Cedar Valley limestone and locally may form biostromes. One of these reefs is especially notable and, having a wide distribution, has been used considerably as a datum plane. This biostrome has commonly been called the "*davidsoni* reef" in county geology reports of Iowa since its main constituent was generally referred to *Acervularia davidsoni* Edwards and Haime. Study of these compound corals has shown that at least six species have been lumped under this specific name, and one of the purposes of this paper is to describe them as distinct forms. Another species. *Acervularia* (*Prismatophyllum*) *profunda* is distinctive of the beds in which it occurs and serves as the marker for the zone.

In this paper, the first of a series on Cedar Valley corals, are described only a few of the nearly fifty species collected from the formation. Until these are described and compared with forms from adjacent regions, it does not at this time seem profitable to make definite correlations based on corals. It may be pointed out, however, that none of our species of *Prismatophyllum* is conspecific with any of those from the Middle Devonian of Ohio described by Miss Stewart (1938). Also our Cedar Valley forms are unlike those four species from the Traverse beds of Michigan described by Sloss (1939); there is even a notable group difference, as in the Iowa forms the major septa extend to the axis, but in the Michigan forms this characteristic is rare. Sloss also suggests that the abundant *Prismatophyllum* of the Cedar Valley beds, presumably *P. cedarensis* n. sp., is intermediate between *P. davidsoni* of the Onondaga and *P. percarinatum* Sloss of the Traverse. It, as well as the other Cedar Valley Prismatophyllums, differs considerably from these species, and the writer does not agree that it is intermediate; in fact it is much closer to the *Prismatophyllum* of the Lime Creek beds of Iowa.

In passing it may be noted here that Sloss' (1939) correlation of the Cedar Valley with the Traverse, hence Hamilton, based on *Diversophyllum*, *Aulacophyllum* and *Cystiphyllum*, is not borne out by the species of *Prismatophyllum* of the two areas; none of those of Iowa occurs in Michigan, and vice versa. Likewise of the 50 described species of brachiopods of the Cedar Valley none is conspecific with a Traverse form; the same may be said of the undescribed brachiopods of the Cedar Valley and of the known echinoderms. Though this evidence is negative, it probably should have considerable weight in any correlation of the Cedar Valley formation.

The type materials on which the descriptions of the new species are based are at present in the collection of the writer. Eventually they will be placed in the care of the University of Iowa and may be consulted there.

The thin sections and polished specimens used in this study are the careful work of Powell W. Miller and Miss Maxine Langford. Their assistance is hereby gratefully acknowledged. Thanks are also due the curators of the Sedgwick Museum, Cambridge England, from whom authentic examples of *Acervularia ananas* var. *ananas* (Linné) were secured. Mr. Guy Campbell of New Albany, Ind., was of considerably service in guiding the writer to several collecting localities near Jeffersonville, Ind.

GENERIC DISCUSSION

The acervularioid corals in the Cedar Val-

ley beds have been placed in the genus *Acervularia* by authors generally. It has been necessary, therefore, to investigate this genus to determine the true position, generically, of our corals,, an undertaking begun some years ago. Two specimens of *Acervularia ananas* var. *ananas* (Linné) were secured from the Sedgwick Museum of Cambridge, England. The specimens are from the Lower Salopian beds of the Wenlock, Shropshire, England, and with several additional specimens personally collected from Much Wenlock, England, are the basis for the following detailed analysis of the genotype of *Acervularia*.

Genus ACERVULARIA Schweigger, 1820

Acervularia SCHWEIGGER, *1820*, Handb. des Naturg., p. 418.—MILNE-EDWARDS and HAIME, 1851, Monographie des polypiers fossiles des terrains palaeozoïques, p. 171.—BARROIS, *1889*, Faune du calcaire d'Erbray, pp. 37–40.—LANG and SMITH, 1927, Geol. Soc. London, Quart. Jour., vol. 83.—SMITH and LANG, *1931*, Annals and Mag. Nat. History, ser. 10, vol. 8, pp. 83–94.

ACERVULARIA ANANAS var. ANANAS (Linné)

Plate 35, figure 4;
Plate 38, figures 1–3

Acervularia ananas var. *ananas* SMITH and LANG, 1931, Annales and Mag. Nat. History, ser. 10, vol. 8.

Corallum cerioid, variable in shape, expanding rapidly from the initial corallite, depressed convex above with more or less irregular surface. Undersurface covered by a wrinkled theca and with the external corallites showing a considerable tendency toward independent growth.

Corallites polygonal in cross section, varying from triangular to hexagonal with very unequal sides, sometimes approaching circularity, increasing by calicinal gemmation. Calices slightly or not at all depressed, bounded by thin, slightly elevated outer walls, which are usually straight. Central portion of each calyx depressed by a pit, variable in depth, vertically walled and usually flat at the bottom, with a slight central node. Rims of the pits distinctly elevated, of variable thickness and height, and may be lower or much higher than the outer walls. Septa thin, sparingly carinate, slightly irregular, in two sets; the primary septa extend to the axis and form a slight pseudocolumella, the secondaries reach the bottom of the central pit.

In transverse section the corallites are seen to be separated by distinct common walls, which are thin, generally straight, sometimes curved, and occasionally slightly crenulate. Septa thin and straight, somewhat irregular toward the periphery; the primaries twisting a little at the axis, the secondaries ending half-way between the center and the inner wall. About half-way to the axis the septa are strongly dilated, so that their sides touch or nearly so. These dilations with the carinae and dissepiments form the inner wall, which is a more or less solid ring enclosing an area from one-third to one-half the diameter of the corallite. It is not, however, always continuous, as some corallites in the same corallum show. It is notable that the inner wall is not localized at the ends of the secondary septa, and that it does not divide the interior of a corallite into a dissepimentarium and a tabularium but into regions which may be designated as peripheral and axial. In the central part of the axial region are the twisted edges of the septa, and between them a few outwardly concave bars, the upturned edges of the tabulae. Dissepiments are few and scattered in the region external to the inner wall but are more numerous and closer together in the axial region and are all concave toward the axis. Carinae appear as short projecting bars extending from the sides of the septa into the interseptal spaces. They are more numerous in the peripheral region but may likewise occur in the axial area.

In a longitudinal section through the center of a corallite the outer wall is thin and usually straight. The inner wall is variable in appearance depending upon the position of the slice. If the section is made near a septum, the wall may be thick, but halfway between the septa it is thin or no thicker than the outer wall. Occasionally it may be so thin as scarcely to be discernible for a short way. The peripheral region is occupied from one-half to three-fourths of its width by dissepiments; these are upwardly arched, usually arranged in horizontal rows, exceedingly variable in size and shape, and sometimes elongate and nearly flat. Be-

tween the dissepiments and the inner wall is a single series of subhorizontal thin, irregularly spaced and shaped plates, which join the dissepiments externally with little or no definite boundary and in some places appear to merge with them. The plates are concave or convex, sometimes quite irregular and in places but little different from dissepiments. In some ways they resemble tabulae and are so regarded by Lang and Smith (1927). In the axial region there are also two groups of structures. In the center occur the tabulae, abundant, thin, convex, more or less horizontal, irregularly spaced and curved, bending abruptly downward distally, where they are readily separable by their angle of slope from the structures adjacent. These occupy the outer half of the central region and are similar in appearance to dissepiments. They are abundant, variable in size, upwardly arched, and directed inward and downward at an angle of about 60°. Several rows may be present between the central tabulae and the inner wall. Carinae are moderately common, thin, and appear on the sides of the septa as short linear ridges arching downward and outward toward the outer wall. They are present in the axial region but more prominent in the peripheral and are visible only when the vertical slice is made near a septum.

Remarks.—Several of the internal features of *Acervularia ananas* var. *ananas* may be given different interpretations from those of Lang and Smith (1927). The tabular structures immediately external to the inner wall are here regarded as dissepiments, for they merge with the latter, are convex in some instances as well as flat, and are situated between the septa and do not appear to pass through them. They are also exterior to the inner wall, and it is unusual among closely related genera to have tabulae in this location. Though some of the tabular dissepiments are convex, others concave, the majority are flat and horizontal, probably because of their proximity to the inner wall, which interrupts their continuity with those within the wall and causes them to loose their convexity. In some instances, the dissepiments exterior to them are flat, long, and but little different.

The inwardly arched structures in the outer part of the central region are so similar to dissepiments in form and arrangement that they can readily be interpreted as such, especially because the area they occupy is also invaded by secondary septa. In transverse section they are concave toward the axis, but the axial tabulae are concave away from it. They are also situated in that part of the corallum which, in related genera, is within the dissepimentarium.

The inner wall does not interrupt the continuity of the septa and appears to be made by the dilation of the septa with aid of dissepiments. Inspections of cross sections of several coralla shows that the wall is not always complete within a corallite and may vary in strength in adjacent corallites of the same corallum. This inner wall of *Acervularia ananas* var. *ananas* may be a true aulos but it does not appear to be, at least not more so than the inner walls of several species of *Prismatophyllum* to be described below.

Occurrence.—Lower Salopian beds of the Wenlock, Shropshire, England.

GENERIC COMPARISON OF CEDAR VALLEY ACERVULARIOID CORALS WITH ACERVULARIA

The Cedar Valley acervularioid corals have many features in common with the genotype of *Acervularia;* among the more important are: the same method of growth of the corallum, the polygonal shape and close aggregation of the corallites, the presence of central pits in the calices, septa in two alternating sets of different length, carinae, an outer series of abundant dissepiments, an inner series of convex axial tabulae, and calicinal gemmation. In addition several Cedar Valley forms have inner walls partly formed by septal dilation and deposits of interstitial material. Several species have a peripheral series of axially inclined dissepiments between the inner wall and axial tabulae. Lastly, the majority have distinct rims about the central pits of the calices, though not as prominent as those of *Acervularia ananas* var. *ananas.*

Several differences are apparent chiefly in longitudinal sections of the corallites. The inner wall of *Acervularia ananas* var. *ananas* is mainly formed by dilation of the

septa and is situated neither at the border of the tabularium nor at or near the ends of the secondary septa; however several Cedar Valley species, e. g. *Prismatophyllum brandonensis*, n. sp., have dilated septa aiding in the formation of the inner wall and one species, *Prismatophyllum multicinctum*, n. sp., has one or two inner walls within the dissepimentarium. *Acervularia ananas* var. *ananas* has more numerous dissepimentlike structures immediately peripheral to the axial tabulae; but *Prismatophyllum brandonensis* and *Prismatophyllum iowensis*, n. sp. show evidence of having more than one row of them as well. The main difference, then, is the lack in our species of the nearly flat, horizontal dissepiments or tabulae, however they may be interpreted, immediately exterior to the inner wall. But Lang and Smith (1927) in their discussion of *Acervularia exigua* suggest that the flat tabular structures exterior to the inner wall of that species may be dissepimental in origin. If this is true, as the writer believes, the differences of generic value between our species and *Acervularia* largely disappear.

However Smith and Lang (1935) regard these differences sufficient to remove *Prismatophyllum prisma* and similar species from *Acervularia* to *Prismatophyllum*, and in this procedure they have been followed recently by several authors. For the present, then, the Cedar Valley corals formerly regarded as members of *Acervularia* are here removed from that genus. Thorough investigation of the genotype of *Prismatophyllum*, *P. prisma* Smith and Lang, was made in order that comparison of our forms could be made with more certainty than at present possible from the literature alone.

Genus PRISMATOPHYLLUM Simpson, 1900

Prismatophyllum SIMPSON, *1900*, New York St. Mus., Bull. 39, vol. 8, p. 218.—SMITH and LANG, *1931*, Annals and Mag. Nat. History, ser. 10, vol. 8.—LANG and SMITH, *1935*, Geol. Soc. London, Quart. Jour., vol. 91, 558, 559.—STEWART, *1938*, Geol. Soc. America, Spec. Paper 8, p. 48.—SLOSS, *1939*, Jour. Paleontology, vol. 13, pp. 68–69.

Prismatophyllum was proposed in 1900 by Simpson, who cited *Cyathophyllum rugosum* Edwards and Haime as the type but stated that this species was not the same as *Astrea rugosa* Hall. Simpson illustrated as his genotype a transverse section of a coral and gave as an example *Prismatophyllum davidsoni* Edwards and Haime, illustrated by cross and longitudinal sections. Some years later Smith and Lang (1935) in discussing the genus *Prismatophyllum* suggested that Simpson's *Prismatophyllum rugosum* was not the same as Edwards and Haime's species, as is apparent from the section given by Simpson. They, therefore, gave the name *Prismatophyllum prisma* to Edwards and Haime's species and suggested that it should be the genotype of *Prismatophyllum*. It may be questioned whether Simpson's illustrated coral should not be the genotype rather than Smith and Lang's *P. prisma*, unnamed at the time. Miss Stewart has expressed the opinion that *Prismatophyllum annum* (Whitfield) is conspecific with Simpson's *P. rugosum*, and her cross section of *P. annum* is very similar to Simpson's illustration of his type coral. If true, and an inspection of Simpson's type should determine, perhaps *P. annum* should be taken for the type. However, until Simpson's specimen can be examined, *Prismatophyllum prisma* may be regarded as the genotype, and the generic characteristics be ascertained from a study of that species.

Comparison of the acervularioid corals in the Cedar Valley beds with *Prismatophyllum prisma* shows that all are congeneric with it and differ only in a few details of specific importance. For the present, therefore, the Cedar Valley forms are referred to the genus *Prismatophyllum* as now recognized. As noted by Lang and Smith, however, generic names proposed by Ludwig antedate *Prismatophyllum*, which may eventually be placed in synonymy.

PRISMATOPHYLLUM PRISMA Smith and Lang
Plate 37, figures 1, 2, 4

Cyathophyllum rugosum EDWARDS and HAIME, *1851*, Monographie des polypiers fossiles des terrains palaeozoïques, p. 387, pl. 12, figs. 1, 1a, 1b.

Prismatophyllum prisma LANG and SMITH, *1935*, Geol. Soc. London, Quart. Jour., vol. 91, pt. 4, p. 558, text figs. 17, 18.—STEWART, *1938*, Geol. Soc. America, Spec. Paper 8, pp. 50–51, pl. 9, figs. 13–15.

Corallum large, massive, cerioid, more or less lenticular. Corallites closely aggregated, polygonal, variable in size and shape, in-

creasing by lateral calicinal gemmation. Calices moderately deep, sloping gradually, then rapidly to the central pits, bounded by low outer walls. Septa numerous, carinate, alternating; the primaries may reach the center, usually twisting slightly there, while the secondaries extend to the sides of the central pit.

In transverse section the outer walls of the corallites are thin, usually crenulate but occasionally straight if the septa of adjoining calices meet the wall directly opposite each other. In an example preserved so that the corallites may be separated, the exterior is strongly, sometimes irregularly, corrugated vertically and horizontally striated. Two areas are distinguishable in the interior, the peripheral dissepimentarium and the axial tabularium. The dissepimentarium is much the larger and comprises the major portion of a corallite and contains most of the dissepiments and carinae. The cylindrical tabularium is about one-third as broad as the major diameter of the corallite and may be slightly more in some instances. The tabularium is usually darker because of more foreign material and because secondary septa, carinae and dissepiments are commonly lacking. Border between the two areas is usually distinct in cross section, in some corallites appearing as a ring of material chiefly dissepimental. If present, it is usually a little peripheral to the ends of the secondary septa. In adjacent corallites the ends of the primaries may fail to reach the center and leave a small space there. Successive sections of the same corallite show that this condition may follow or succeed that in which the septa reach the axis. Secondary septa extend only two-thirds the distance to the center, where they end abruptly. Dissepiments moderately numerous, concave axially, farther apart peripherally and close together axially. Carinae not abundant, thin, usually confined to the dissepimentarium.

In the longitudinal and axial section of a corallite the two regions are distinct. The dissepimentarium is occupied by numerous short, upwardly and sometimes inwardly arching dissepiments, variable in size and arrangement. Carinae, depending on the nearness of the section to a septum, appear as lines, few in number and arching outward and downward toward the outer wall; most of them stop at the border of the tabularium, only a few enter it. The tabularium is usually distinctly divided from the dissepimentarium by a nearly straight line formed by the walls of a series of nearly vertical elongated dissepiments. Tabulae are thin, irregularly intersected by a few septa, more or less horizontal, axially elevated and depressed near the border, irregularly spaced, often close together, flat or slightly concave and generally extending across the tabularium. At the periphery of the tabularium may occur a few scattered, inwardly convex, axially sloping structures similar in appearance to dissepiments. These may form a series of periaxial axially arched tabulae; if so, it is not strongly developed.

Remarks.—Smith and Lang (1935) in their diagnosis of *Prismatophyllum* mention an axial series of tabulae and a periaxially inclined series. Several sections were made of corallites of *P. prisma*, and in none of them could the writer detect a periaxial series or at least none more than weakly developed. It may be suggested that this

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EXPLANATION OF PLATE 35

FIGS. *1*—*Prismatophyllum multicinctum* Stainbrook, n. sp. Calicinal view of a paratype, M.A.S. 1212, Brandon, Iowa. (p. 282)

2, 3—*Prismatophyllum cedarensis* Stainbrook, n. sp. *2*. Calicinal view, ×2, of a paratype, M.A.S. 1186. *3*, Calicinal view of part of the holotype, M.A.S. 1194, both from Brandon, Iowa. (p. 276)

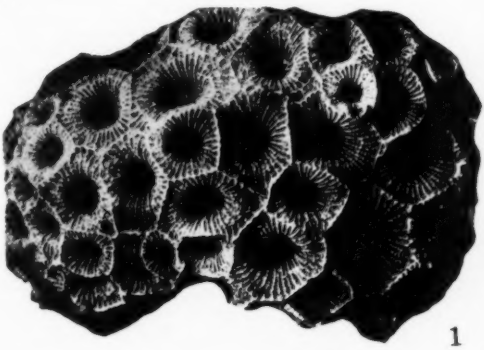
4—*Acervularia ananas* var. *ananas* (L.). Calicinal view of part of a corallum, M.A.S. 1175, Wenlock, England. (p. 271)

5—*Prismatophyllum brandonensis* Stainbrook, n. sp. Calicinal view of part of the holotype, M.A.S. 1189, Brandon, Iowa. (p. 279)

6—*Prismatophyllum parvulum* Stainbrook, n. sp. Calicinal view of part of the holotype, M.A.S. 1187, Brandon, Iowa. (p. 279)

7—*Prismatophyllum iowensis* Stainbrook, n. sp. Calicinal view of part of the holotype, M.A.S. 1180, Brandon, Iowa. (p. 280)

All views are natural size unless otherwise noted.



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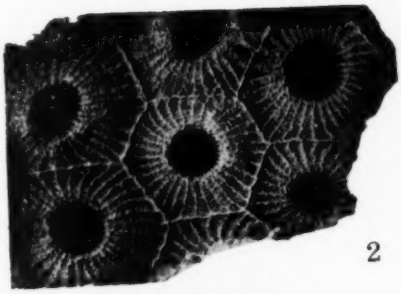

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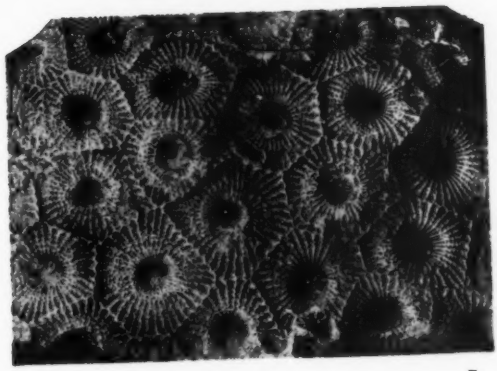

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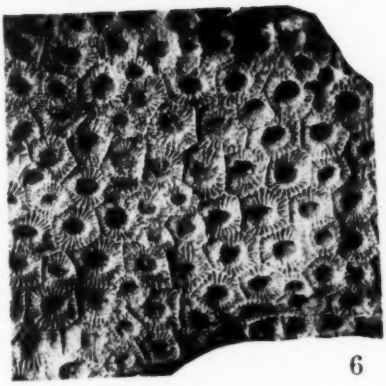

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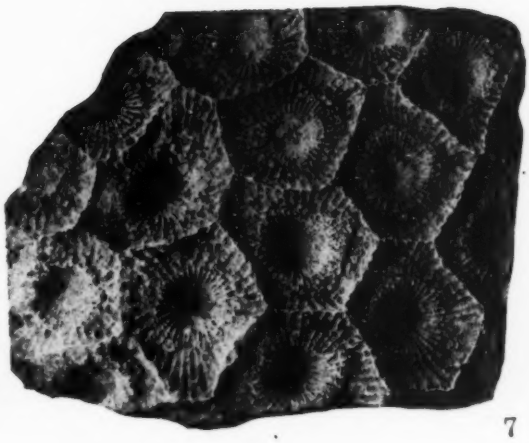

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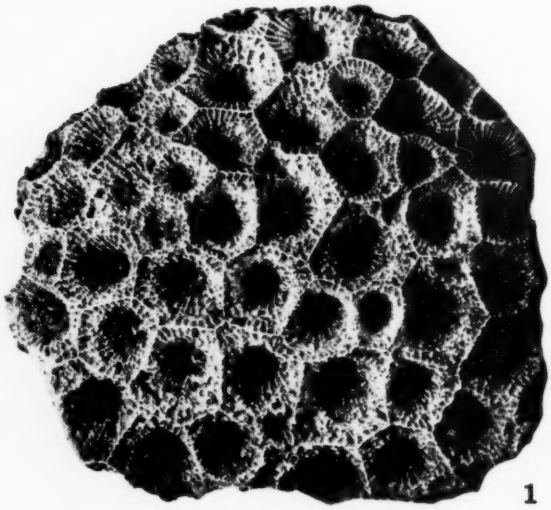
Stainbrook, Devonian Corals



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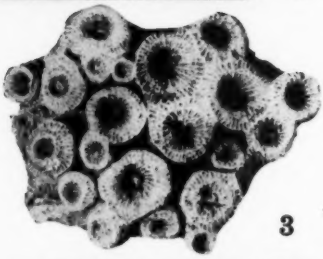

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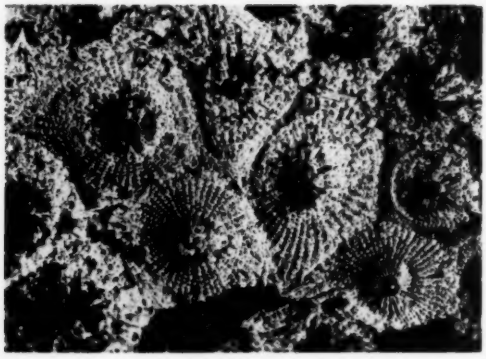

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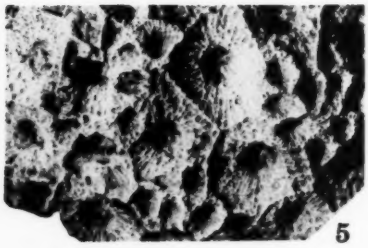

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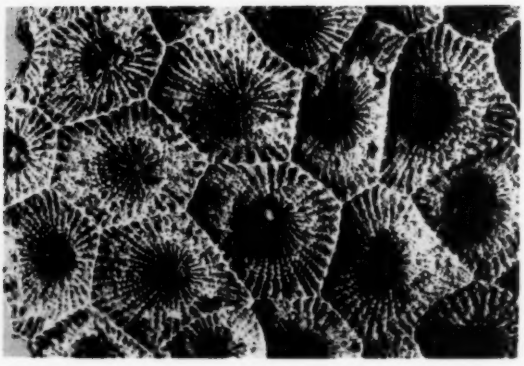

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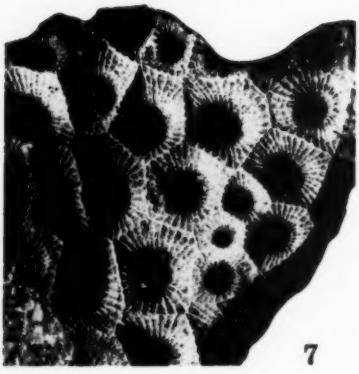

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Stainbrook, Devonian Corals

series of tabulae is not characteristic of the genus. In this connection Sloss (1939) has recently described four species of *Prismatophyllum* from Michigan and states that in each the tabulae are not differentiated. In the present paper, only three of the eight species have this series of tabulae. Since they so closely resemble dissepiments it is possible that they are dissepimental in origin.

Topotypes on which this generic study is based are from the Jeffersonville limestone at Jeffersonville, Ind., on the flat just below the dam across the Ohio River. They are in the writer's collection.

SPECIFIC DESCRIPTIONS

The first species described below is not from the Cedar Valley beds but is here included to clear up some of the confusion in nomenclature in the previous identifications of our corals.

PRISMATOPHYLLUM CINCTUM
Stainbrook, n. sp.
Plate 37, figures 3, 5, 6; plate 36, figure 4

Corallum medium to large, cerioid, massive, composed of closely aggregated corallites forming more or less lenticular masses. Corallites large, up to 18 mm in greatest diameter, irregularly polygonal, and increasing by lateral calicinal gemmation. Calices of moderate depth, with the bottom sloping rapidly from the outer walls half the distance to the axis and then abruptly to the central pits. Septa strongly carinate to the border of the central pits.

In transverse section the outer walls of the corallites are thin, usually straight, sometimes curved, and occasionally slightly crenulate. Septa numerous, about 46 or 48 in large corallites, generally straight, sometimes slightly crenulate, in two alternating sets. Outside the tabularium the septa are thin but within are usually thickened, sometimes strongly so, and a short way toward the axis each septum turns sharply toward its neighbor on one side, nearly touches it and forms a sort of inner ring. Within this the septa are very thin and twisted into an axial plexus. Secondary septa are similar to the primary but extend only a short way into the tabularium, where they are likewise thickened. Tabularium large, having a diameter about half that of a corallite, and appears to be divided into two areas by the ring formed by the curved thickened edges of the primary septa. The border of the tabularium is marked by an inner wall, which is thick in some examples. It varies in development and seems to be formed by the thickening of the septa in conjunction with dissepiments and carinae. It coincides with the wall of the central pit in the calyx. Carinae numerous, very short, extending only a short way into the interseptal spaces, usually directly opposite on either side of a septum but occasionally alternating. Dissepiments thin, concave toward the axis, and not so apparent in cross section.

In longitudinal section the two areas are separated by a distinct, thin, straight, vertical wall, which is not easily distinguished except where the section is cut half-way between two septa. In the tabularium also two areas are distinguishable: the axial area, marked by the tangled edges of the septa with a few short horizontal tabular edges between; and the peripheral area, in which

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EXPLANATION OF PLATE 36

FIGS. *1, 2—Prismatophyllum profundum* (Hall). *1*, Calicinal view of a hypotype, M.A.S. 782, northeast of Vinton, Iowa. *2*, Lateral view of a specimen showing cylindrical corallites one inch high rising from typical polygonal corallites, M.A.S. 782, Brandon, Iowa. (p. 281)

3—Prismatophyllum multicinctum Stainbrook, n. sp. Calicinal view of a specimen showing cylindrical corallites rising from typically polygonal ones, M.A.S. 1228, Brandon, Iowa. (p. 282)

4—Prismatophyllum cinctum Stainbrook, n. sp. Calicinal view of a paratype, M.A.S. 1227, Jeffersonville limestone, Jeffersonville, Ind. (p. 275)

5, 6—Prismatophyllum iowensis Stainbrook, n. sp. *5*, Calicinal view of a specimen showing multiple gemmation, M.A.S. 777. *6*, Calicinal view of a paratype, M.A.S. 1199. Both from Brandon, Iowa. (p. 280)

7—Prismatophyllum lativentrum Stainbrook, n. sp. Calicinal view of part of the holotype, M.A.S. 1215, Brandon, Iowa. (p. 283)

All views are natural size.

the tabulae are regular in appearance, horizontal, usually concave, occasionally flat, regularly spaced, and close together. A periaxial axially inclined series of tabulae is not present. In the dissepimentarium the dissepiments are abundant, upwardly and inwardly convex, a little variable in size. The carinae are numerous, prominent and arch outward from the border of the tabularium to the outer wall of the corallite.

Remarks.—Prismatophyllum cinctum is the species commonly called *Acervularia davidsoni* Edwards and Haime but differs from that form as pointed out by Miss Stewart (1938) in possessing carinae. Most of our acervularioid corals have commonly been identified with this species, and for this reason it is here described and figured.

Simpson cited *Acervularia davidsoni* Edwards and Haime as an example of his new genus *Prismatophyllum*, but neither his cross section nor the longitudinal section is similar to those of *Prismatophyllum cinctum*.

From the Cedar Valley forms of the same genus, *Prismatophyllum cinctum* may be distinguished by the larger size of the calices, the strong axial twisting of the major septa, the generally strong development of the inner wall, and the presence of the secondary ring of curved septa in the tabularium.

Prismatophyllum cinctum has smaller corallites on the average than *Prismatophyllum prisma*, has less crenulate outer walls, has a more strongly marked, often thick inner wall, more abundant carinae, septa thickened within the peripheral portion of the tabularium, and primary septa strongly twisted at the axis. The inner ring in the tabularium formed by the curved septa is especially distinctive and in silicified specimens forms a vertical-walled pit below the bottom of the central pit of a calyx.

The inner wall along with the thickening of the septa seems to be a variable feature, for in the same corallum it may be well developed in a corallite and less distinct in an adjacent one. Again, a section made above the first section will often show the wall to be indistinct in the same corallite and well-developed in its neighbor. Apparently the wall varied in thickness as the coral polyp grew upward.

Occurrence.—Jeffersonville limestone at Jeffersonville, Ind., on the flat below the dam across the Ohio River.

Types.—Holotype M.A.S. 1198; paratypes M.A.S. 1172.

PRISMATOPHYLLUM CEDARENSIS Stainbrook, n. sp.

Plate 35, figures 2, 3; plate 40, figures 3, 4

Acervularia davidsoni? HALL, *1858*, Geology of Iowa, vol. 1, pt. 2, pp. 476, 477, figs. 8 a, b.—CALVIN, *1892* (part), Am. Geologist, vol. 9, pp. 355–358.

Corallum large, some examples measuring as much as 1½ feet in diameter and up to six inches in thickness, lenticular, usually depressed convex above, flattened beneath, circular in outline except where crowded or otherwise disturbed. Undersurface irregularly and concentrically wrinkled and showing rounded external corallites; epitheca thick and displaying, where unworn, numerous fine growth lines and the septal edges beneath. Corallites growing from one initial corallite, sometimes from several, spreading upward, increasing by lateral calicinal budding, closely aggregated and showing slight tendency toward independent growth.

Upper surface more or less irregular, sometimes smooth. Calices mostly hexagonal, ranging from 8 to 11 mm in diameter and averaging in most examples about 10 mm; bounded by thin erect walls, which are usually straight and about half a millimeter above the floors; shallow, depressed centrally by deep straight-sided, flat-bottomed pits averaging 1.5 mm in diameter or slightly less than one-third that of the

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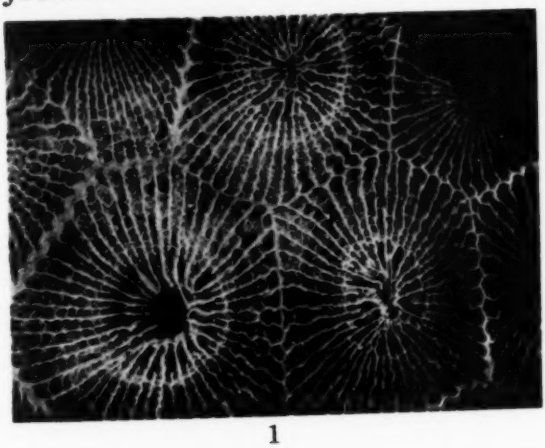
EXPLANATION OF PLATE 37

FIGS. *1, 2, 4—Prismatophyllum prisma* Smith and Lang. *1*, Transverse section, ×2, of a hypotype, M.A.S. 1173. *2, 4*, Longitudinal sections, ×2, of two corallites from the same specimen to show scarcity of dissepimentlike tabulae in the outer part of the tabularium. Jeffersonville limestone, Jeffersonville, Ind. (p. 273)

3, 5, 6—Prismatophyllum cinctum Stainbrook, n. sp. *3*, Transverse section of a paratype, ×2. M.A.S. 1172. *5, 6*, Transverse and longitudinal sections, ×2, of the holotype, M.A.S. 1198. Both from the Jeffersonville limestone, Jeffersonville, Ind. (p. 275)



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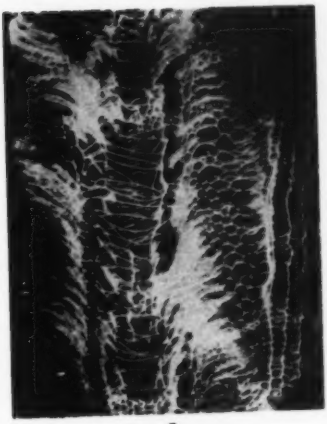

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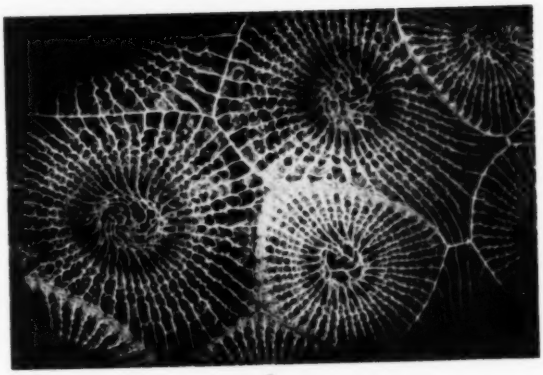

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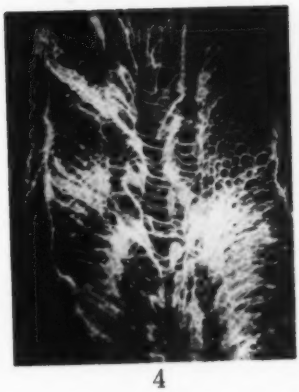

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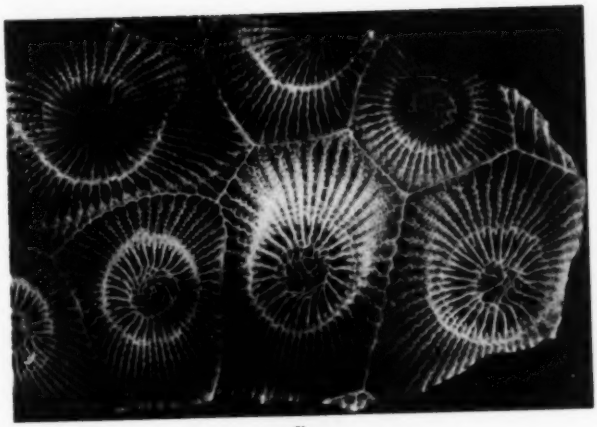

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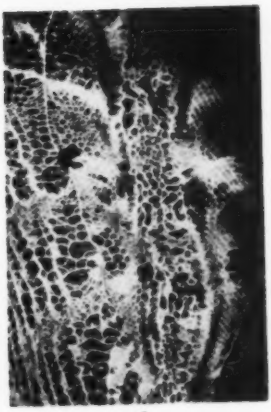

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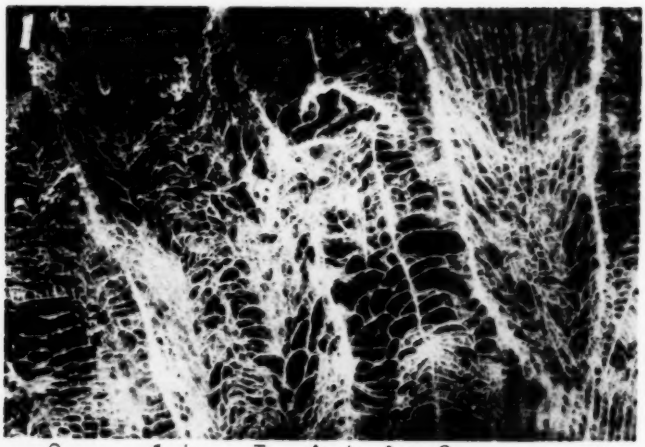
Stainbrook, Devonian Corals



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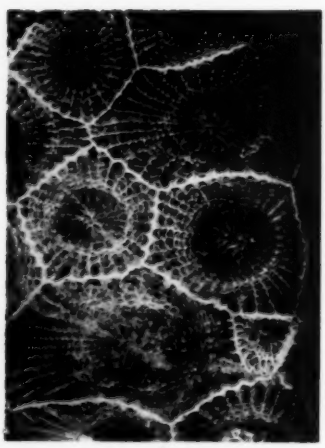

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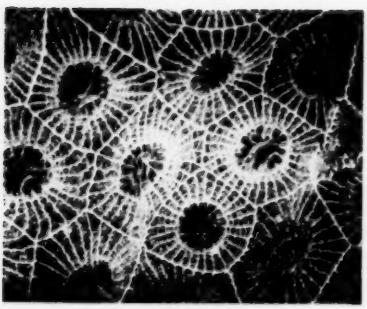

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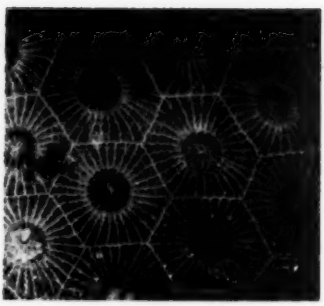

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Stainbrook, Devonian Corals

corallites; rims about the pits distinctly elevated, being sometimes higher than the outer walls, with the surface sloping peripherally and making a shallow depression near the outer wall. Septa numerous, somewhat variable in number, ranging from 28 or less to 34, the average being 30; all extending well down into the central pits, but only the primary group reaching the center, where they twist and form a slight pseudocolumella; free edges sharp, serrate in well-preserved calices, and carinate. Carinae more numerous in the peripheral area and fewer in the central pit, about 8 being the average number on each septum in the outer area, and those of adjacent septa may alternate or may join, thus making a complete bar across the interseptal spaces.

In the transverse section of a corallite two regions are visible—the tabularium, corresponding to the central pit in the calyx, and the dissepimentarium, corresponding to its elevated part. The boundary between them is marked by the crowding and coalescing of the dissepiments and the carinae, by the edges of the tabulae, by the ends of the secondary septa, and by the slight thickening of all septa. In the tabularium the septa are thin, extend to the axis, and twist slightly. Between them appear the edges of a few axial tabulae irregularly distributed. In the dissepimentarium the septa are straight, sometimes slightly crenulate, and are enlarged or a little nodose where crossed by carinae. Dissepiments are moderately numerous, more or less regularly disposed, and in some instances indistinguishable from the plates formed by the junction of carinae with those of adjacent septa. Outer walls in most examples are straight and thin but may be slightly crenulate.

In a vertical section made through the peripheral area of a corallite the septa are continuous from the calyx downward; dissepiments are abundant between them and are gently concave or flat; from them, carinae appear to be distinguished by the abrupt downward turn from the sides of the septa to the middle of the interseptal spaces. In a vertical section made through the center of a corallite and between two septa the carinae appear as thin straight plates, regularly disposed and inclined outward and downward from the tabularium to the outer wall at an angle of about 70°. Crossing them at right angles, the upwardly convex dissepiments descend gently away from the outer walls inwardly toward the center; each may extend across the space between two or more carinae. In the tabularium are numerous tabulae, thin and generally horizontal in position, more or less regularly spaced, strongly convex axially, irregular, and interrupted by the somewhat wrinkled and twisted septa; peripherally they are concave and regular in appearance. No peripheral series of tabulae similar to dissepiments is present.

Remarks.—Following Hall (1858), *Prismatophyllum cedarensis* has commonly been identified as *Acervularia davidsoni* Edwards and Haime. This name, as recently noted by Miss Stewart (1938), should be applied to a species in France that lacks carinae. As carinae are strongly developed in *Prismatophyllum cedarensis*, the forms are evidently not conspecific. From the Onondaga form usually called *Acervularia davidsoni* and in this paper described as *P. cinctum*, *P. cedarensis* differs in having smaller corallites, fewer septa (30 instead of 48), and a less strongly developed inner wall. The

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EXPLANATION OF PLATE 38

FIGS. *1–3*—*Acervularia ananas* var. *ananas* (L.). *1*, Longitudinal section, ×4, M.A.S. 1174; *O*, outer wall, *I*, inner wall, *T*, tabulae, *D*, dissepimentlike tabulae, *H*, horizontal tabulae. *2*, Transverse section, ×2, M.A.S. 1172, showing dilated septa, carinae, tabulae and dissepiments. *3*, Transverse section, ×2, printed from a film strip used as the negative, same specimen as *1*. All from the Silurian of Shropshire, England. (p. 271)

4—*Prismatophyllum lativentrum* Stainbrook, n. sp. Transverse section, ×2, of the holotype, M.A.S. 1215, Brandon, Iowa. (p. 283)

5–7—*Prismatophyllum parvulum* Stainbrook, n. sp. *1*, *2*, Transverse and longitudinal sections of the holotype, ×2, M.A.S. 1187. *3*, Transverse section of a specimen showing regularly hexagonal corallites with the septa reaching the axes, M.A.S. 1208. Both from Brandon, Iowa. (p. 279)

septa of *P. cedarensis* also do not twist so strongly at the axis nor do they form an inner ring within the tabularium.

Calvin has shown how this form differs from *Prismatophyllum profundum*, and his conclusions may be briefly summarized. *Prismatophyllum profundum* is coarser, shows a greater tendency toward independent development of the corallites, has larger and very deep calices, which have no distinct central pits surrounded by raised peripheral areas, and has more numerous and more distinctly carinate septa.

Prismatophyllum cedarensis has larger corallites than either *Prismatophyllum inaequalis* (Hall and Whitfield) or *P. whitfieldi* (Fenton and Fenton) (not *P. whitfieldi* Stewart). It is readily distinguished from *Prismatophyllum bassleri* (Webster and Fenton) by possessing slightly larger corallites and differently shaped, not funnellike calices. It has larger corallites and fewer septa than *Prismatophyllum bassleri depressum* (Fenton and Fenton), and calices are not funnel-shaped. *Prismatophyllum bassleri magnum* (Fenton and Fenton) has much larger corallites and more septa.

Occurrence.—Cedar Valley limestone in the *pentamerella* zone and forming a biostrome in most localities. Widespread in the Cedar Valley area in Iowa from southern Minnesota to northwestern Illinois.

Types.—Holotype M.A.S. 1194; paratypes M.A.S. 1207 and 1186.

PRISMATOPHYLLUM THOMASI
Stainbrook, n. sp.
Plate 40, figures 1, 2

Acervularia davidsoni Calvin, *1892* (part), Am. Geologist, vol. 9, p. 355 et seq.

Corallum large, attaining dimensions as much as 18 inches in diameter and 10 inches in thickness, broadly convex above, rounded below, often irregular in growth, composed of closely approximated corallites, which show little tendency toward independent growth.

Upper surface usually more or less smooth, often somewhat irregular. Calices subequal in size, averaging about 11.2 mm in diameter, irregularly polygonal, with one diameter larger than the others, separated by erect bounding walls, which are slightly zigzag, shallow, with depressed, slightly concave peripheral areas, which may slope gently upward from the walls; central pits large, vertically walled, gently concave at the bottom, a little more than a millimeter in depth and in breadth averaging about half the calicinal diameter. Septa averaging about 44 in number in mature calices, thin, carinate, arranged in two sets, those of the primary set reaching the axes of the calices.

In cross section the two areas of the interior of the corallites are readily apparent; the border between them is strongly developed, being formed by the crowding of the dissepiments and carinae in conjunction with the edges of the tabulae. Bounding walls relatively thick, nearly always strongly zigzag, with the septa of adjacent corallites abutting the wall alternately. Septa thin and straight, the primaries extending to the center, where the ends may be slightly twisted; the secondaries usually end at the border of the tabularium. Dissepiments crowded in the axial part of the dissepimentarium but sparser toward the periphery; carinae sparse. The tabularium has a diameter one-half to two-thirds that of the corallite and displays few or no structures between the septa.

In the longitudinal section the outer walls are stout and slightly irregular. The dissepiments are abundant, a little variable in size and shape. Carinae are numerous, thin, arching outward and downward from the border of the tabularium. Tabulae numerous, slightly irregular, more or less evenly spaced, horizontal, elevated and flat axially, concave peripherally. There is no definite series of axially inclined tabulae, but there may be a few scattered ones similar in form to dissepiments.

Remarks.—This species has often been confused with *Prismatophyllum cedarensis*, as both were formerly referred to *Acervularia davidsoni* and no distinction was made between them. Several differences allow the two Cedar Valley forms to be separated readily. In size of calices both species vary within about the same limits but those of *Prismatophyllum thomasi* average a millimeter larger. Septa are more numerous in this species, as the average number is 44 in comparison to 30 in the other form. The most conspicuous difference is seen in cross sections, where the bounding walls of the

corallites are zigzag while those of *P. cedarensis* are straight. This difference is also usually visible in worn specimens. The size of the calices, the number of the septa and the calicinal profile will separate this form from any other in the same beds. As far as now known it is the latest species to develop in the formation.

Occurrence.—Cedar Valley limestone in the *Cranaena iowensis* zone and often forming a biostrome at Mid River (type locality), Rapid Creek, Linder's Boathouse and Iowa City in Johnson county.

Types.—Holotype M.A.S. 1193; paratype 1204.

PRISMATOPHYLLUM PARVULUM Stainbrook, n. sp.
Plate 35, figure 6; plate 38, figures 5–7

Corallum of medium size, variable in shape, gently convex above and turbinate below, formed by closely aggregated corallites, which increase by calicinal budding and show little or no tendency toward independent growth. Dimensions up to 8 inches in diameter may be attained. Under surface somewhat irregular, with the upper surface slightly undulant.

Corallites small, nearly uniform in size, usually a little irregularly polygonal but often regularly hexagonal. Calices shallow, separated by thin erect walls, averaging about 6.5 mm in diameter, their floors generally flat, slightly concave peripherally and depressed axially by small circular pits a millimeter in depth, with vertical walls and flat bottoms; rims of the pits slightly convex and but little elevated. Septa thin, straight, carinate, averaging 30, alternately long and short, the primaries reaching the center.

In cross section the common walls between the corallites are thin, sometimes slightly crenulate, but usually straight. The secondary septa end abruptly at the border of the tabularium, within which the primaries are thin and slightly irregular. In the dissepimentarium the dissepiments are crowded near the middle but scattered toward the walls. Carinae are numerous, nodose where they join the septa. Dissepimentarium sharply separated from the tabularium by a ring formed of closely aggregated dissepiments. A few edges of the tabulae show between the septa within the tabularium.

In longitudinal section the outer walls of the corallites are nearly straight. Tabulae are elevated axially, irregularly shaped and spaced, usually flat or concave peripherally. A few scattered, convex, inwardly sloping dissepimentlike structures are the only evidence of a periaxial inclined series of tabulae. Dissepiments are abundant, small, variable in size and shape. Carinae are few, thin, and steeply inclined toward the outer wall. In a section in the periphery of a corallite the septa are gently undulant transversely.

Remarks.—The small size of the corallites and the shallowness of the calices readily separate this form from other members of the genus occurring in the same beds. It is very near *Prismatophyllum inaequalis* (Hall and Whitney) of the Cerro Gordo substage but has slightly smaller corallites on the average and shows more regularity in the shapes and sizes of the much shallower calices.

Occurrence.—Cedar Valley limestone in the *Pentamerella* zone with *Prismatophyllum cedarensis* at Brandon and Buffalo, Iowa.

Types.—Holotype M.A.S. 1187; paratype 1190.

PRISMATOPHYLLUM BRANDONENSIS Stainbrook, n. sp.
Plate 35, figure 5; plate 40, figures 5, 6

Corallum of medium size, usually circular, broadly convex above and below, composed of closely aggregated corallites, which expand rapidly from the initial point. The holotype, an elongate specimen and somewhat incomplete, has a major diameter of four inches. Corallites polygonal, more or less regularly hexagonal and increasing by calicinal gemmation.

Upper surface generally flat, slightly irregular in some examples due to uneven calicinal growth. Calices large, attaining a maximum diameter of 16.8 mm or more and averaging slightly less; distinctly separated by the thin vertical zigzag walls, which are less than a millimeter in height; floors depressed centrally by broad, shallow pits, which have gently concave bottoms, steeply sloping walls, and depths varying considerably but usually 2 mm or less. Rims about

the central pits of the calices distinctly elevated, nearly as high as the outer walls, broadly convex and depressed toward the periphery. Septa numerous, 38 being the average number in the mature corallite, stout, serrated, nodose where crossed by carinae, in two sets; the members of the primary set extending to the bottom of the central pit, the secondaries limited to its sides. Carinae abundant, stout, those on one side of a septum generally alternating with those on the other side as well as with those on the opposite septum.

Internally in transverse section the common walls are thin, generally crenulate and a little curved. The border between the two areas moderately well developed, formed by the slight dilation of the septa and crowding of the carinae and dissepiments. Septa thin and straight, slightly thicker half-way to the axis and attenuate beyond. The primary septa extend to the center and twist a little; the secondary septa project a short way into the tabularium. In the disseptimentarium the carinae and dissepiments are abundant and crowded in the axial portion. In larger corallites the interseptal spaces may be nearly filled with these structures in a characteristic manner. In the tabularia of some corallites more than in others, a few bars may appear, the upturned edges of the tabulae.

In a longitudinal section the dissepiments are slightly variable in size and shape, usually small. Carinae are numerous, close together, and sloping from the inner border of the tabularium at an angle of about 45°. Axial tabulae are abundant, short, horizontal, convex or flat, a little irregular in shape and spacing; peripheral tabulae well developed, short, axially inclined.

Remarks.—With one exception *Prismatophyllum brandonensis* is readily separated from other species present in the Cedar Valley beds by the large size of its corallites. From *Prismatophyllum iowensis*, *P. brandonensis* differs in having shallower calices, with smaller and shallower central pits, elevated rims about the central pits, septa dilated at their midlength, and distinctly crenulate outer walls. From *Prismatophyllum bassleri magnum* (Fenton and Fenton) of the Owen substage it differs in possessing smaller corallites, shallower and differently shaped calices and fewer septa.

Occurrence.—Cedar Valley limestone in the *pentamerella* zone with *Prismatophyllum cedarensis* at Brandon, Shellsburg, Randalia, etc., in Iowa.

Types.—Holotype M.A.S. 1189; paratypes M.A.S. 1181 and 1185.

Prismatophyllum iowensis
Stainbrook, n. sp.
Plate 35, figure 7; plate 36, figures 5, 6; plate 39, figures 5, 6

Corallum ceroid, medium to large, lenticular, depressed convex above, composed of closely aggregated corallites, which show little tendency toward independent growth. The type specimen is about 12 inches in diameter and four inches thick.

Calices large, some attaining a major diameter of 23 mm, averaging about 17 mm; variably and irregularly polygonal, and separated by thin erect common walls; the floors slope gently from the walls to the borders of the central pits and then abruptly to the bottom; central pits large, having diameters half that of the calices, rounded at the bottom, and with the rims but little elevated. Septa stout, serrate, strongly carinate, straight, numbering about 40, alternating; the primaries extend to the axis of the corallite and twist slightly to form a small pseudocolumella, the secondaries reach the bottom of the central pit.

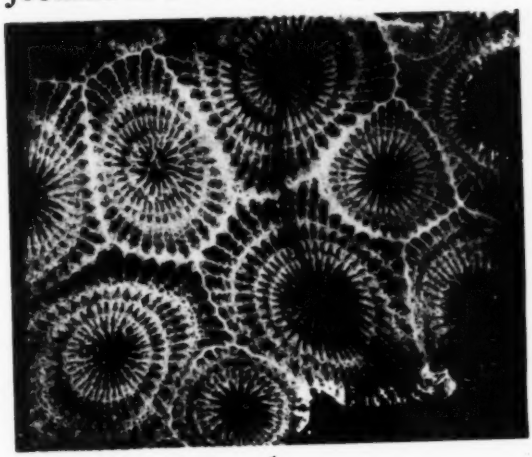
In transverse section the outer walls are slightly undulant or straight. Septa thin, straight or curved but not crenulate; the secondaries extend a slight way into the tabularium. Dissepimentarium wide but not strongly marked at the inner border, which is formed by several circlets of dissepiments.

Explanation of Plate 39

Figs. *1, 2—Prismatophyllum multicinctum* Stainbrook n. sp. Transverse and longitudinal sections, ×2, of the holotype, M.A.S. 778, from Brandon, Iowa. (p. 282)

3, 4—Prismatophyllum profundum (Hall). Transverse and longitudinal sections, ×2, of a hypotype, M.A.S. 1210, from Brandon, Iowa. (p. 281)

5, 6—Prismatophyllum iowensis Stainbrook, n. sp. Transverse and longitudinal sections, ×2, of the holotype, M.A.S. 1180, from Brandon, Iowa. (p. 280)



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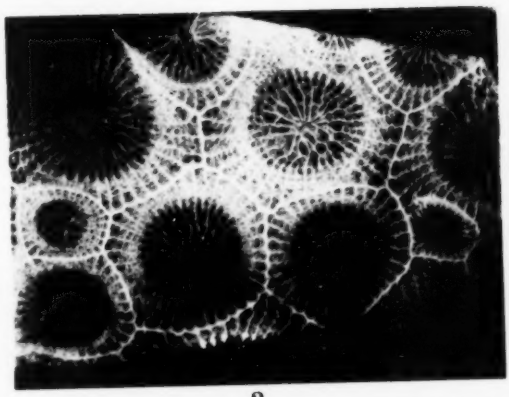

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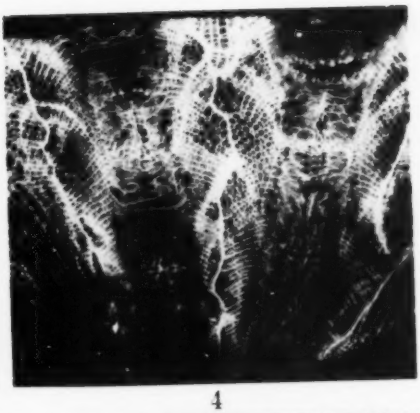

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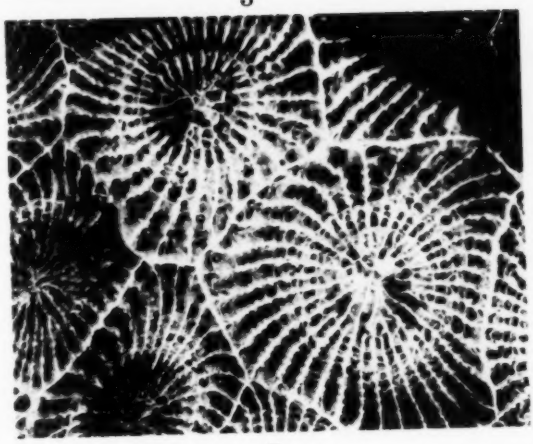

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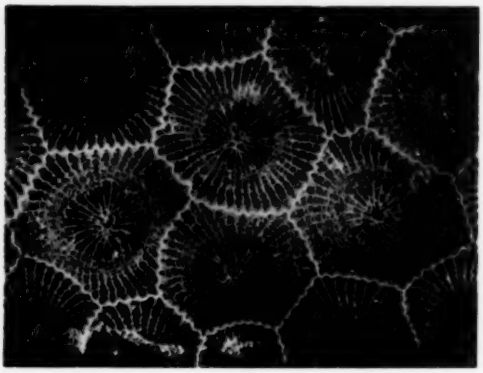
Stainbrook, Devonian Corals



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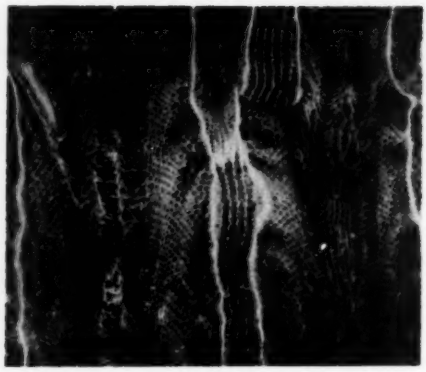

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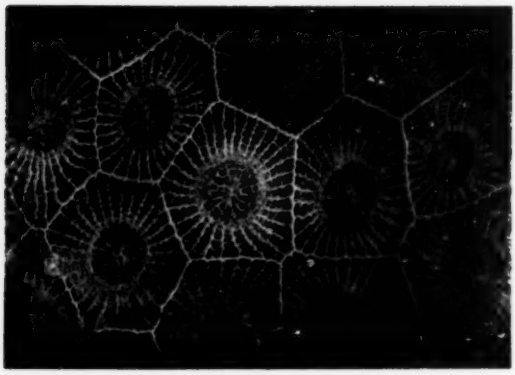

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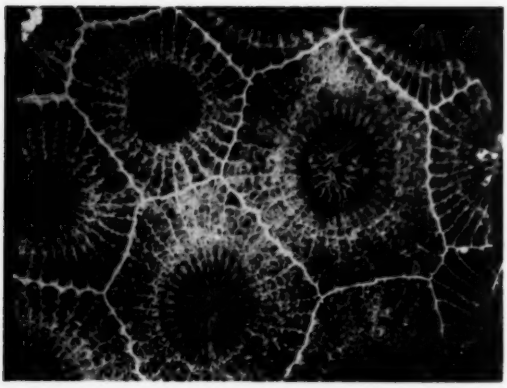

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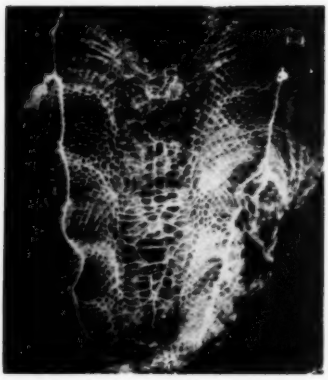

6

Stainbrook, Devonian Corals

Dissepiments abundant, not crowded axially; carinae short, moderately numerous. Tabularium large and showing a number of tabular edges.

In longitudinal section the outer walls are moderately thick and slightly sinuous. The tabularium is about one-third as wide as the corallite and shows two types of tabulae; an axial series of broad, horizontal, gently convex tabulae, irregularly spaced, and a peripheral series of inwardly arched short convex tabulae which resemble dissepiments. Dissepimentarium notable for the abundant carinae, thin, closely spaced, more or less obscuring the abundant small dissepiments.

Remarks.—Prismatophyllum iowensis is distinguished from most members of the genus occurring in the Cedar Valley beds by the large size of its corallites. It is separated from *Prismatophyllum brandonensis* in the possession of deeper calices with broader, more flaring central pits and narrower, not elevated areas about them, not crenulate outer walls as seen in cross sections, and more closely approximated carinae. From *Prismatophyllum bassleri magnum* (Fenton and Fenton) it is distinguished by fewer septa and corallites of more uniform size. As no specimens of *P. magnum* are at hand, comparison of internal structures of the two species cannot be made at this time.

Occurrence.—Cedar Valley limestone in the upper part of the *profunda* zone and the lower part of the *bellula* zone at Brandon, Shellsburg, and Urbana, Iowa.

Types.—Holotype M.A.S. 1180; paratypes M.A.S. 777 and 1199.

PRISMATOPHYLLUM PROFUNDUM (Hall)
Plate 36, figures 1, 2; plate 39, figures 3, 4

Acervularia profunda HALL, *1858*, Geology Iowa, vol. I, pt. 2, pp. 476, 477, pl. 1, figs. 7a–c.—CALVIN, *1892*, Am. Geologist, vol. 9, pp. 355–358; Iowa Acad. Sci., Proc., vol. 1, pt. 2, pp. 30–32.

Corallum of medium to large size, attaining dimensions as much as one foot in diameter and six inches in thickness, variable in shape, often increasing slowly from the initial corallite and forming a pyriform structure, convex above, more or less irregular in growth, and often uneven; composed of closely aggregated polygonal corallites, which are separated by distinct common outer walls and increase by calicinal budding. Under surface showing growth wrinkles and the rounded forms of the exterior corallites, which exhibit a strong tendency toward independent growth. Epitheca concentrically much wrinkled and marked vertically by slight linear depressions showing the positions of the septa beneath.

Upper surface occasionally regular but more often irregular because of the differential growth of the individual polyps. In some instances single corallites, cylindrical in shape, may project considerably above the common surface. Calices variably polygonal in shape, with as few as three sides and as many as eight, differing in size depending on the recency of the divisions of the polyps, and attaining diameters as large as 15 mm with the average from 13 to 15 mm; deep, about 8 mm in the average calyx, with the sides sloping rapidly from the erect bounding walls and then abruptly to the bottom, which is nearly flat, marked by a slight central elevation, and about one-third as broad as the corallite. The central pits have such small rims that they may be said to coincide with the calices. Septa numerous, about 40 being the average number in fully developed calices, stout, sharply serrate, and strongly carinated; the primaries twist slightly at the center to form a small pseudocolumella, while the secondaries extend down to the bottom of the central pits. Carinae on adjacent septa may alternate or in some instances coincide.

Cross sections of the corallites show them

EXPLANATION OF PLATE 40

FIGS. *1, 2—Prismatophyllum thomasi* Stainbrook, n. sp. Transverse and longitudinal sections, ×2, of the holotype, M.A.S. 1193, from the *Cranaena iowensis* zone at Iowa City, Iowa. (p. 278)

3, 4—Prismatophyllum cedarensis Stainbrook, n. sp. Transverse and longitudinal sections, ×2, of a paratype, M.A.S. 1207, Brandon, Iowa. (p. 276)

5, 6—Prismatophyllum brandonensis Stainbrook, n. sp. Transverse and longitudinal sections ×2, of the holotype. M.A.S. 1189, Brandon, Iowa. Dilated septa and crowding of the carinae and dissepiments especially notable. (p. 279)

to be separated by thin outer walls, which are usually straight, as in most instances the septa on either side of the wall are directly opposite each other; occasionally where the septa alternate the walls may be slightly crenulate. Septa thin and straight, the secondaries projecting a short distance into the tabularium. Boundary between the tabularium and dissepimentarium distinct, formed by the close aggregation of carinae and dissepiments and a little interstitial material. Tabularium large, occupying the major part of a corallite, in some instances nearly touching the outer walls. Within it, the septa are tenuous and irregular and may be connected by a few tabular edges. Dissepimentarium narrow, showing numerous dissepiments and abundant, short, somewhat irregular carinae.

In longitudinal section the outer walls are a little irregular. Dissepiments numerous, small, variable in size and shape, inwardly convex; carinae thin and close together. Tabulae in two series; axial tabulae broad, horizontal, flat or slightly convex, extending nearly across the tabularium; peripheral tabulae short, axially inclined, inwardly convex, and resembling dissepiments.

Remarks.—*Prismatophyllum profundum* is a marked species easily distinguished by its method of growth, large corallites, deep calices and numerous, strongly carinate septa. It differs from *Prismatophyllum multicinctum* in having deeper, broader central pits with little or no rims about them, smaller calices as a rule, and only one, less distinct inner wall. The species always occurs below *Prismatophyllum cedarensis* in company with *Billingsastrea billingsi* (Calvin) and is usually confined to the *profunda* zone. However, scattered individuals have been collected in the subjacent *independensis* zone in northern Iowa. So far as known the species is limited to the Cedar Valley beds. References of this form to other regions are probably erroneous.

Occurrence.—Cedar Valley limestone in the *profunda* zone in the upper part of the *independensis* zone. Widespread in Iowa, southern Minnesota and northeastern Illinois.

Types.—Hypotypes M. A. S. 776, 1205, 1210, 1213.

PRISMATOPHYLLUM MULTICINCTUM Stainbrook, n. sp.

Plate 35, figure 1; plate 36, figure 3; plate 39, figures 1, 2

Corallum cerioid, depressed convex above, usually elongate conical below, expanding with moderate rapidity from the initial corallite, sometimes from several, of medium size, attaining in one specimen a diameter of five inches and a height of five inches. Corallites closely aggregated as a rule, displaying considerable tendency toward independent growth, variably polygonal in shape, and in some instances growing separately.

Calices deep, large, in one specimen having a major diameter of 20 mm but averaging about 15 mm. Any corallum may show a considerable number of small ones depending on recency of gemmation. They are separated by strong erect common walls which may be slightly crenulate. From the outer walls the floors of the calices slope gradually for a short distance, then abruptly to the bottom of the large central pits. Septa stout, serrate, strongly carinate, numbering about 40 in mature calices; the primary septa reach the axes and twist, forming small pseudocolumellas, the secondaries extend only to the bottoms of the central pits.

In cross section the common walls appear to be thick and slightly crenulate. The interior is not biareal in appearance, for instead of one wall situated at the boundary of the tabularium, there may be several; in one instance four are visible in a corallite. These inner walls appear to be formed by slight dilation of the septa and by deposition of interstitial material in addition to the carinae and dissepiments. The tabularium is small, less than a third as wide as the corallite, and chiefly defined peripherally by the ending of the secondary septa, as there may be several walls beyond and one within. The septa are thin, except where dilated, and straight, but axially may be a little irregular. Dissepiments and carinae abundant.

In longitudinal section the outer walls are thin and often irregular. The dissepimentarium is broad, nearly twice as wide as the tabularium in some instances; dissepiments abundant, small; carinae well developed,

thin, close together, strongly arched outward and downward. Tabulae in two series; axial tabulae short, horizontal, gently convex or flat, irregularly spaced; peripheral tabulae axially inclined, arched and short and similar to dissepiments. Inner walls appear as a successive series of infundibuliform cups in the corallite, flat axially, gradually expanding upward, and flaring near the outer wall, Thus the outer border of the tabularium is not marked by a continuous wall as in other species. The infundibuliform structures appear to represent successive depositions of material in the calices at intervals of several millimeters.

Remarks.—*Prismatophyllum multicinctum* is very similar to *Prismatophyllum profundum* and has usually been included in that species. A number of differences are readily apparent. Calices are considerably larger on the average in *P. multicinctum* and proportionately not as deep, are explanate, and have a wider rim about the central pits; tabularium of *P. multicinctum* is much narrower and occupies only a small portion of a corallite, but in *P. profundum* it takes up the major portion. The presence of several inner walls in *P. multicinctum* is distinctive, as in *P. profundum* there is only one, which always forms the outer border of the tabularium. The large size of the calices, the deep, broad, central pits, and the method of growth separate this form from others of the genus in the Cedar Valley formation.

In several specimens at hand the corallites of the outer part of the corallum are independent of each other and cylindrical in form. They may attain a height of one inch above the common surface. Wherever two or more touch they unite with a common outer wall.

The development of the inner walls is somewhat variable in different coralla; in some they may be thin and appear as a continuous ring of dissepiments, and in others they are thick and are formed by the thickening of the septa along with crowding of the dissepiments and carinae. In one specimen otherwise typical the inner walls are but faintly developed.

Occurrence.—Cedar Valley limestone in the *profunda* zone at Brandon, Littleton, Urbana, and Shellsburg, Iowa.

Types.—Holotype M.A.S. 778; paratypes M.A.S. 78, 783, 1200, 1201, and 1212.

PRISMATOPHYLLUM LATIVENTRUM
Stainbrook, n. sp.
Plate 36, figure 7; plate 38, figure 4

Corallum cerioid, lenticular, large, attaining a diameter of ten inches, composed of closely aggregated corallites, which are variable in size and shape. Calices averaging about 13 mm in diameter, separated by thin, low, erect common walls, deep and with the floors sloping rapidly for a short distance beyond the wall, then abruptly into the central pits. Central pit large, nearly half as broad as a corallite, flat-bottomed, and surrounded by a narrow sloping rim. Septa weakly carinate, averaging about 34, thin and straight; the primaries reach the axis and twist, the secondaries extend only down the sides of the central pits.

In cross section of a corallite the outer walls are stout, slightly crenulate and a little curved. Septa thin and straight, slightly irregular axially. Tabularium large, and displaying numerous tabular edges. Tabularium not always distinctly differentiated from the dissepimentarium as the ring of dissepiments and carinae may be weakly developed. Dissepiments thin, scattered, more abundant axially; carinae short, often alternating on either side of a sepum.

In longitudinal sections the walls of the corallites are a little irregular. The tabulae are in two series; the axial tabulae horizontal, convex, often irregular, and of moderate length; the peripheral tabulae are short, convex, variable, axially inclined and dissepimental in appearance. In the dissepimentarium the dissepiments are abundant, small, variable in shape and size; the carinae are numerous, thin, and close together.

Remarks.—*Prismatophyllum lativentrum* is readily separable from *P. cedarensis*, with which it occurs, by the deep calices, by the large central pits, and by the presence of a peripheral series of dissepimentlike tabulae. At first glance *P. lativentrum* appears to be conspecific with *P. profundum*, but a number of differences are apparent on close study. From *P. profundum*, *P. lativentrum* is distinguished by having smaller calices, smaller central pits, sloping rims about the

pits, fewer and less strongly carinate septa; internally the outer walls of *P. lativentrum* are crenulate instead of straight, the tabularia proportionately much smaller, and the carinae fewer and farther apart. It is probable, however, that *P. lativentrum* descended from *P. profundum*. From *P. bassleri* (Fenton and Fenton) it differs in having a less rapidly sloping rim about the central pits, slightly larger corallites and crenulate common walls as seen in cross section.

Occurrence.—Cedar Valley limestone in the *pentamerella* zone at Brandon, Shellsburg, and Randalia, Iowa.

Types.—Holotype M.A.S. 1215; paratype 1192.

REFERENCES

EDWARDS and HAIME, *1851, Monographie des polypiers fossiles des terraines palaeozoïques*, p. 171, p. 414.

HALL, JAMES, *1858, Iowa Geol. Survey*, vol. 1, pt. 2, p. 476.

LANG, W. D. and SMITH, S., *1927, Geol. Soc. London, Quart. Jour.*, vol. 83, pp. 448–490.

SIMPSON, G. B., *1900, New York State Mus., Bull.* 39, pp. 199–222.

SLOSS, L. L., *1939, Jour. Paleontology*, vol. 13, no. 1, pp. 52–73.

SMITH, S., and LANG, W. D., *1931, Annals and Mag. Nat. History*, ser. 10, vol. 8, pp. 83–94.

——, *1935, Geol. Soc. London, Quart. Jour.*, vol. 91, pp. 558, 559.

STEWART, GRACE A., *1938*, Middle Devonian Corals of Ohio: *Geol. Soc. America, Special Paper* 8.

JOURNAL OF PALEONTOLOGY, VOL. 14, NO. 3, pp. 285–286, MAY, 1940

PALEONTOLOGICAL NOTES

ANEVDA, NEW NAME FOR ADVENA PALMER, 1937, NOT GUDE, 1913

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The name *Advena* having been used in 1913 by G. K. Gude[1] for a new genus of pulmonate gastopods, I propose the name *Anevda* to replace *Advena* which I gave to a new genus of dibranchiate cephalopods in 1937.[2] The genotype of *Anevda* is *Advena* (=*Anevda*) *floweri* Palmer.

[1] GUDE, G. K., *1913*, Definitions of further new genera of Zonitidae: *Mal. Soc. London, Proc.*, vol. 10, p. 391.

Thanks are extended to Dr. Horace B. Baker, Zoological Laboratory, University of Pennsylvania, for his courtesy in calling my attention to the duplication in the use of the name *Advena*.

[2] PALMER, K. V. W., *1937*, The Claibornian Scaphopoda, Gastropoda and dibranchiate Cephalopoda of the southern United States: *Bull. Am. Paleontology*, vol. 7, no. 32, p. 510.

MANUSCRIPT RECEIVED BY THE EDITOR JANUARY 17, 1940.

PREOCCUPIED SPECIFIC NAMES OF ARABELLITES

CLINTON R. STAUFFER
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Dr. E. R. Eller of the Carnegie Museum, Pittsburgh, has kindly called my attention to the use of four preoccupied names for species of *Arabellites* described in my recent paper on "Middle Devonian Polychaeta from the Lake Erie district." I therefore take this opportunity to substitute new names in place of those unavailable because of prior use.

ARABELLITES CUSHINGI Stauffer, new name

Arabellites minutus STAUFFER, 1939, Jour. Paleontology, vol. 13, p. 503, pl. 57, fig. 21. Not *Arabellites minutus* Stauffer, 1933.

ARABELLITES MILLERI Stauffer, new name

Arabellites modestus STAUFFER, 1939, Jour. Paleontology, vol. 13, p. 503, pl. 58, figs. 43, 45. Not *Arabellites modestus* Stauffer, 1933.

ARABELLITES PROSSERI Stauffer, new name

Arabellites priscus STAUFFER, 1939, Jour. Paleontology, vol. 13, p. 504, pl. 58, fig. 18. Not *Arabellites priscus* Stauffer, 1933.

ARABELLITES SOUTHWORTHI Stauffer, new name

Arabellites robustus STAUFFER, 1939, Jour. Paleontology, vol. 13, p. 504, pl. 58, fig. 49. Not *Arabellites robustus* Eller, 1934.

MANUSCRIPT RECEIVED BY THE EDITOR DECEMBER 18, 1939.

NUCULA CAMIA GARDNER, NEW NAME

JULIA GARDNER
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Dr. Hubert G. Schenck, of Leland Stanford University, has kindly called my attention to *Nucula amica* Barrande, 1881, which antedates *N. amica* Gardner, 1915. I hereby offer *N. camia* in place of the preoccupied name. The type, which is deposited in the U. S. National Museum, is from the Upper Cretaceous Monmouth formation at Brightseat, 1 mile west of Friendly, Prince Georges County, Md.

PROPOSED REVISION OF NORTH AMERICAN INDEX FOSSILS

H. W. SHIMER and R. R. SHROCK
Massachusetts Institute of Technology, Cambridge, Mass.

North American Index Fossils by A. W. Grabau and H. W. Shimer is now being revised by Professors H. W. Shimer and R. R. Shrock of the Massachusetts Institute of Technology. The Institute is to underwrite the new edition as a Technology Press Publication. John Wiley and Sons, Inc., will distribute the book. Doctors Grabau, Shimer, and Shrock have assigned all royalities to the Technology Press to help defray the cost of production. Revision, therefore, is a work of love.

Because of the broad paleontological field covered and the great volume of literature that has to be examined, the revisers are calling upon their colleagues for assistance of various kinds, and so far the response has been very encouraging. At present the revisers would greatly appreciate reprints of articles (especially those that have been published during the past twenty-five years) which contain descriptions of important genera and species, changes in classification, faunal lists, and distribution data. They especially desire papers printed in the less well known scientific publications of the United States, Canada, and Mexico.

Present plans call for complete rewriting of all text matter, with elimination of keys and other parts no longer considered essential; and new illustrations of most fossils, with figures collected on full-page plates rather than scattered throughout the text as in the first edition. Suggestions concerning scope, emphasis, format, and organization of the proposed new edition will be greatly appreciated and sympathetically considered. It is hoped that revision may be completed in about two years.

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DEPÉRET, PROF. CHARLES. Died May 17, 1929.
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KOKEN, E. Died Nov. 24, 1912.
KOLINA, DR. JAN. Died April 7, 1939.
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POMPECKI, DR. J. F. Died July 8, 1930.
STEFANINI, PROF. G. Died Sept. 15, 1938.
WOODWARD, DR. H. Died Sept. 6, 1921.

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